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Introduction

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **919**

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Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **965**

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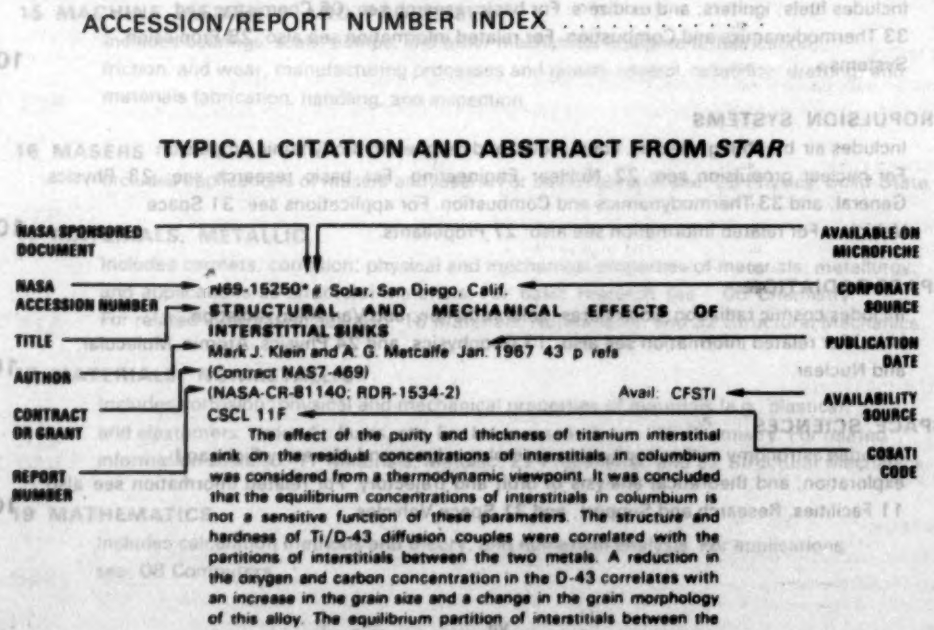
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The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

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N69-16121*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY STUDY OF EFFECTS OF REYNOLDS NUMBER AND BOUNDARY-LAYER TRANSITION LOCATION ON SHOCK-INDUCED SEPARATION

James A. Blackwell, Jr. Washington Jan. 1969 27 p refs Paper presented at AGARD Specialists' Meeting on Transonic Aerodyn., Paris, Sep. 1968; sponsored by AGARD

(NASA-TN-D-5003) Avail: CFSTI CSCL 20D

A two-dimensional experimental and theoretical investigation was conducted on an airfoil to determine the effect of Reynolds number and transition location on shock-induced separated flow. The experimental investigation was conducted in the 8-foot transonic pressure tunnel at Mach numbers from 0.60 to 0.80, angles of attack from 0° to 4°, and Reynolds numbers from 3.0×10^6 to 16.8×10^6. Transition locations from 0.05 to 0.50 chord were utilized. The results indicate that variation of the Reynolds number from full-scale values to the usual wind-tunnel values results in substantial changes in the shock location, trailing-edge pressure recovery, and boundary-layer losses at the trailing edge. By properly fixing the boundary-layer transition point on the wind-tunnel model, full-scale results can be simulated at the usual wind-tunnel Reynolds numbers. The required location of the transition point can be predicted theoretically with acceptable accuracy by simulating the boundary-layer characteristics at the airfoil trailing edge. Author

N69-16125 Illinois Univ., Urbana.

STABILITY OF ELASTIC COLUMNS SUBJECT TO TRANSIENT LOADING

Siegfried Mathias Holzer (Ph.D. Thesis) 1968 108 p

Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-8116

The stability analysis is based on Liapunov's direct method. The conditions of stability are deduced from the characteristics of a class of Liapunov functions constructed for this problem. The stability criterion developed for simply supported columns determines a bound on the transverse motion of the column relative to the amplitude and duration of a prescribed force pulse and a set of initial perturbations. The stability of simply supported columns is discussed for three types of loading: a constant thrust of infinite duration, a variable thrust of infinite duration, and transient thrusts of parabolic and transcendental shapes. The quality of the bounds is ascertained through comparison with the trajectory of the differential equation of motion, obtained by numerical integration. Dissert. Abstr.

N69-16160*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PREDICTION OF LIFT AND DRAG FOR SLENDER SHARP-EDGE DELTA WINGS IN GROUND PROXIMITY

Charles H. Fox, Jr. Washington Jan. 1969 38 p

(NASA-TN-D-4891) Avail: CFSTI CSCL 01A

A method of predicting the lift and drag of slender planar sharp-edge delta wings in ground proximity is described, and the results are compared with experimental data. The method utilizes a vortex-lattice computer program incorporating an image technique to compute the potential-flow normal-force and axial-force characteristics of delta wings in ground proximity. A recently published vortex-lift concept in free air based on a leading-edge-suction analogy is utilized, and a method is presented for combining it with the results of the potential-flow theory in ground proximity. A comparison of the theoretical and experimental lift and drag for delta wings with a wide range of aspect ratios is presented at selected angles of attack. The comparison indicates that this method provides a reasonably good prediction of the lift and drag in ground proximity for aspect ratios less than 2.0 in the angle-of-attack range from 5° to 15°. Author

N69-16209*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL SURFACE-PRESSURE DISTRIBUTIONS ON A 9° SPHERICALLY BLUNTED CONE AT MACH NUMBERS FROM 1.50 TO 4.63

Wallace C. Sawyer and Rudeen S. Smith Washington Jan. 1969 60 p refs

(NASA-TM-X-1730) Avail: CFSTI CSCL 20D

An investigation was conducted in a wind tunnel to determine the pressure distributions on a 9° spherically blunted cone at Mach numbers from 1.50 to 4.63 with Reynolds numbers of 2.25×10^6 and 3.00×10^6 per foot (7.38×10^6 and 9.84×10^6 per meter). Angle of attack was varied from 0° to 12°. The surface pressures were integrated in order to obtain forebody forces and moments. The experimental surface pressures and integral forces and moments were compared with an existing theoretical method which predicts surface pressures and aerodynamic characteristics. Comparison of the experimental and theoretical results showed good agreement for surface pressures at moderate angles of attack except at the lower Mach numbers. Comparison of the results for

forces and moments generally showed good agreement. The process of integrating surface pressures has been programmed for high speed digital computation. The program is written so that it will apply to arbitrary bodies of revolution. For convenience, the program is presented with the necessary operating details. Author

N69-16378# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIFTING SURFACE IN TRANSONIC GAS FLOW
A. N. Panchenkov 5 Mar. 1968 20 p refs Transl. into ENGLISH from Gidrodinam. Bol'shikh Skorostei (Moscow), no. 3, 1967 p 7–20
(AD-678821; FTD-MT-24-25-68) Avail: CFSTI CSCL 1/3

Lifting surface motion in the subsonic gas flow is studied. A method is developed for solving three-dimensional problems in a nonlinear approximation. The method is based on a concept of mapping of n-dimensional Euclidean space in a new space. The new space is selected in such a manner that its linear problem yields results which are accurate to terms of the second order of smallness along the perturbation parameter. The method makes it possible to study an extensive class of three-dimensional problems in the transonic region. In this work problems were studied for a symmetric, solid and thin wing in two and three-dimensional flows. The new results were obtained according to the dimensionless number in transonic flow. Author (TAB)

N69-16457# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLOW PAST A PERMEABLE CONE AT AN ANGLE OF ATTACK
Ye. M. Kalinin *In its* Fluid and Gas Mech. (Selected Articles) 25 Oct. 1967 p 7–10 refs (See N69-16455 08-12)
Avail: CFSTI

This paper deals with the problem of a permeable cone in supersonic flow at an angle of attack. It is assumed that the cone surface is uniformly permeable, the angle of attack is small, and the pressure p_1 inside the cone is constant with $p_1 < p_{2\ min}$ where $p_{2\ min}$ is the minimum surface pressure on the impermeable cone with the same flow regime. This problem is reduced to the solution of the equation of flow potential which is presented as the sum of three potentials $\Phi = \Phi_1 + \Phi_2 + \Phi_3$, where Φ_1 is the potential of a plane-parallel flow of velocity $V_\infty \sin \alpha$; Φ_2 is the potential of an axisymmetrical flow past a cone and independent from Θ; Φ_3 is the potential which takes nonsymmetrical effects into account. Expressions are derived for lift and drag coefficients and for the aerodynamic moment with respect to the cone apex. Author

N69-16460*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ROUGHNESS DRAG DUE TO TWO-DIMENSIONAL FABRICATION-TYPE SURFACE ROUGHNESS ON AN OGIVE CYLINDER FROM FORCE TESTS AT TRANSONIC SPEEDS
K. R. Czarnecki and William J. Monta Washington Jan. 1969 48 p refs
(NASA-TN-D-5004) Avail: CFSTI CSCL 20D

An investigation has been made in the transonic Mach number range from 0.70 to 1.20 and over a range of free stream Reynolds number per foot from about 0.8×10^6 to 6.0×10^6 (2.6×10^6 to 19.7×10^6 per meter) to determine by means of force tests the roughness drag due to essentially two dimensional fabrication-type surface roughness immersed in a turbulent boundary layer. Six types of surface roughness, including step, wave, crease, and swept configurations, were investigated. The tests were made on an ogive cylinder of fineness ratio 12.2, the roughness elements covering the cylindrical portion of the models. Some force test data obtained previously on the these models at Mach numbers of 1.61 and 2.01 have been included as an aid to the analysis, and a comparison is made of the force test results with those results obtained from the pressure distribution investigations and with supersonic wave drag theory. The investigation indicated that roughness elements submerged in a turbulent boundary layer had drag characteristics very much like those of bodies in a uniform free stream as the Mach number was increased or the roughness sweep angle was changed. There was, however, a strong influence of change in Reynolds number of boundary layer thickness on the drag characteristics when substantial wave drag was present. Author

N69-16467*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF AIR BEARING LIFT PADS
Dan H. Dane and Herman T. Blaise Washington Jan. 1969 21 p
(NASA-TM-X-1724) Avail: CFSTI CSCL 01C

If a loaded air pad would float 0.317 cm (0.125 in.) above the floor, the drag would be almost zero, and the floor surface would not affect the performance of the air pad. Raising a precision air bearing or bladder air bearing higher than the air film layer by supplying more air to the pads produces unacceptable vibrations. Lowering the volume of air from a ground effects machine to get the desired effect produces statically unstable conditions. To provide a frictionless lift capacity on rough floors, a mathematical model of an air bearing lift pad (air pad) that floats 0.317 cm off the surface was devised, manufactured, and successfully tested. Three of these air bearing lift pads were assembled into a cushion air pad platform that had a load carrying capacity exceeding 45.4 kg (100 lb) over a rough floor with less than 0.284 N (1 oz) friction drag. Seven upgraded units were designed and manufactured to support 136 kg (300 lb) for the serpentuator testing program and for general simulation use. Author

N69-16468# Aircraft Research Association, Ltd., Bedford (England).
AERODYNAMIC STUDY OF HELICOPTER BLADE SECTIONS
Ph. Poisson-Quinton and A. de Sievers Sep. 1968 37 p refs Transl. into ENGLISH of ONERA paper ONERA-TP-495 Presented at AGARD Conf. on Aerodyn. of Helicopter Blades, Goettingen, W. Ger., 11–13 Sep. 1967
(ARA-LIB-TRANS-17; ONERA-TP-495) Avail: CFSTI

For the aerodynamic calculation of a helicopter rotor, familiarity with the two dimensional characteristics of blade airfoil sections is necessary; here the main objective is to increase the maximum lift (retreating blade at a Mach number from 0.2 to 0.4), and to reduce the minimum drag (advancing blade at M from 0.7 to 1), both being subjected to compressibility effects at high forward speeds. A special test rig for two dimensional transonic investigations is being built to simulate correctly the local Mach and Reynolds numbers of a modern rotor in flight. Preliminary research in incompressible flow has dealt with the effect of manufacturing imperfections of a real helicopter blade, and with the improvement of maximum lift and L/D by means of a cambered nose modification to an existing symmetric airfoil section; the theoretical calculation for the symmetrical and cambered profiles was carried out by rheolectric methods in incompressible perfect flow; the good agreement between the electrical analogue computations and the experimental results shows that this method is very useful for rapid optimization of a family of profiles corresponding to given criteria. Author

N69-16812# ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF WIND TUNNEL TESTS ON AFMDC MONORAIL CONE AND SPIKE NOSE SLED CONFIGURATIONS AT MACH NUMBERS FROM 2.0 TO 5.0
Final Technical Report, 27 Feb.–23 Apr. 1968

W. T. Strike, Jr. and E. J. Lucas Arnold Eng. Develop. Center Dec. 1968 69 p refs
(Contract F40600-69-C-0001)
(AD-679206; AEDC-TR-68-198) Avail: CFSTI CSCL 14/2

An evaluation was made of the results of wind tunnel tests on 0.4-scale models of two monorail rocket-sled configurations. The sled models consisted of a cylindrical body with forward and aft splitter wedges and slippers and with an interchangeable 15-deg cone nose and spike nose. The wind tunnel tests were conducted at Mach numbers 2, 3, 4, and 5 and over a Reynolds number range (based on the sled body diameter) from 0.22 to 1.92 million. The sled model was sting supported over a scaled replica of the Holloman track rail which was supported on a sharp-leading-edge ground plane (flat plate). The test results consist of static force measurements obtained from a six-component strain-gage balance. Also, pitot pressure flow field surveys were made over the ground plane and model rail in the region occupied by the sled model. The following model parameters were varied during the test: the location of the sled relative to the rail tip and also to the ground plane leading edge, the height of the sled body above the rail surface, the gap between the slipper and rail surface, and the sled roll angle. The results presented include an evaluation of the influence of the sled slippers, the free-stream Reynolds number, and the Mach number on the aerodynamic loading of the sled. Author (TAB)

N69-17002# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
COMPRESSIBILITY EFFECTS ON OSCILLATING ROTOR BLADES IN HOVERING FLIGHT
W. P. Jones and B. M. Rao Oct. 1968 42 p refs
(Contract DAHC04-69-C-0015)
(AD-678624; THEMIS-AED-1; AROD-T-5-2-E) Avail: CFSTI CSCL 20/4

A theory is developed and used for determining the influence of compressibility on the aerodynamic forces acting on helicopter rotor blades when oscillating in hovering flight. The usual two-dimensional mathematical model of the flow is adopted in which a section of the reference rotor blade and its helical wake is replaced by an airfoil with a straight wake and a system of regularly spaced infinite wakes below, the amount of spacing depending on the downward flow induced by the rotor and the number of blades. Author (TAB)

N69-17094 Boeing Co., Seattle, Wash.
SUPPRESSION OF EFFECTS, CAUSED BY MANEUVERS OF THE PILOT, IN THE ANALYSIS OF ACCELERATIONS CAUSED BY TURBULENCE OF THE ATMOSPHERE
Guy Thomasset Sep. 1968 16 p refs Transl. into ENGLISH from French Presented at ICAS Meeting, Munich
(F-240) Avail: Issuing Activity

The statistical distribution of atmospheric turbulence levels can be obtained directly from the flight record of accelerations of an aircraft, after calibration of its energy and frequency transfer. When these accleration are partially due to pilot maneuvers, the distribution function of the tubulence is subject to errors. An analog method for suppression of the accelerations due to pilot maneuvers is proposed. It is based on the automatic, instantaneous computation of accelerations, contributed by actuation of the elevation controls. An analog computer is used to simulate the behavior of an aircraft in flight. A comparison is offered between aircraft accelerations before and after correction, and a new aspect is considered for utilization of commercial aircraft in the measurement of turbulence of the terrestrial atmosphere. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N69-16384*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LARGE SCALE WIND TUNNEL INVESTIGATION TO IMPROVE THE LOW SPEED LONGITUDINAL STABILITY AT HIGH LIFT OF A SUPERSONIC TRANSPORT WITH VARIABLE-SWEEP WINGS
Anthony M. Cook and Dale G. Jones Washington Jan. 1969 57 p refs
(NASA-TN-D-5005) Avail: CFSTI CSCL 01A

An investigation has been made in the Ames 40- by 80-Foot Wind Tunnel to develop techniques to improve the longitudinal stability for a supersonic transport. The model had a wing pivot outboard of the fuselage, a high aspect ratio movable wing panel, and a highly swept, fixed, inboard wing portion (strake). Special efforts were made to minimize the adverse effects of the vortex flow from the highly swept strake leading edge. Flow control devices tested on the strake included increased leading edge radius, leading edge (Krueger-type) flaps, and upper surface vortex generators. Fences on both strake and movable wing panel were also tested. The results show the basic model with a sharp strake leading edge to have pitch-up at an angle of attack as low as 5°. The use of a larger strake leading edge radius together with a strake leading edge flap and a wing fence produced essentially linear pitching moment characteristics to 18° angle of attack, with a stable break at stall. A combination of vortex generators on the strake upper surface, and a wing fence outboard of the pivot also produced acceptable pitching moment characteristics. Author

N69-16464*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
LOW TIP SPEED FAN NOISE DEMONSTRATION PROGRAM
R. E. Motsinger, R. M. Hochheiser, W. R. Minzner, E. E. Smith, M. J. Benzakein et al [1968] 669 p refs
(Contract NAS3-11166)
(NASA-CR-72456; R68AEG482) Avail: CFSTI CSCL 01B

Noise levels are presented for a two stage fan, high bypass ratio turbofan engine, having a fan rotor tip speed of 1000 ft/sec. (305 m/sec.), pressure ratio of 1.45, bypass ratio of 5:1, and a thrust of 20,000 lb. (89,000 newtons) at the sea level static, standard day takeoff power setting. All noise data given in the report are for a bare engine, i.e. no sound absorption treatment was used during the tests. Data are presented as measured around a 225' (68.6 m) radius and as estimated for the 200' (60.9 m) sideline, for a 1000' (304.8 m) level flyover at the takeoff power setting, and for a 300' (91.4m) level flyover at the "approach" power setting. Correlations of the measured noise levels with aerodynamic parameters are included. Author

N69-16827# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Flight Dynamics Lab.
FLY-BY-WIRE FLIGHT CONTROL SYSTEMS
J. P. Sutherland Sep. 1968 39 p refs Presented at the Joint Meeting of Flight Mech. and Guidance and Control Panels of AGARD, Oslo
(AD-679158) Avail: CFSTI CSCL 1/3

The purpose of the paper is to provide the reader with an introduction to fly-by-wire and an outline of state-of-the-art fly-by-wire techniques. An outline of the philosophy of fly-by-wire flight control systems is given, the evolution of fly-by-wire is discussed, the advantages of fly-by-wire over mechanical systems are listed, current fly-by-wire techniques are outlined, and a brief review of in-house and contracted fly-by-wire development programs is given. Author (TAB)

N69-16923*# Bell Aerosystems Co., Buffalo, N. Y.
DESCRIPTION OF AN ENERGY MANAGEMENT SYSTEM FOR THE X-15
William G. Cockayne Jun. 1968 143 p refs
(Contract NAS4-1002)
(NASA-CR-96008) Avail: CFSTI CSCL 01C

The current form of the X-15 EMS is described in equation form. The X-15 EMS is designed to be mechanized on a digital computer, either ground based for simulation or airborne for flight testing. A general description of the X-15 EMS and the digital computer mechanization of it is included. This description is in word form and is applicable to both the SDS 930 and ALERT computer programs. The basic equations are presented in the same order and form in which they are mechanized in the two programs. Where equations pertaining to different functions are intermingled in the programs, they are separated in the report for clarity. Where the forms of the equations are different in the two programs, these differences are pointed out. A description of the symbology used in this report and the associated symbology used in the SDS 930 and ALERT computer programs are described, along with all the codes and discrete indicators. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N69-16101*# TRW Equipment Labs., Cleveland, Ohio. Materials Technology.
MATERIALS FOR ELECTROCHEMICAL CELL SEPARATORS
J. W. Vogt Dec. 1968 141 p refs
(Contract NAS3-8522)
(NASA-CR-72493; TRW-ER-7055-4) Avail: CFSTI CSCL 10C

Experimental data are presented on the properties of fuel cell grade asbestos and of alternate materials for application in alkaline-electrolyte electrochemical cell separators. Chrysotile asbestos mats were tested to determine their physical properties, chemical and electrochemical compatibility, electrolyte absorption and retention, bubble pressure, and electrolytic resistance. The results were excellent, with the main shortcoming considered to be the lack of chemical compatibility with the KOH electrolyte at temperatures over 100°C. Of the alternate fibrous inorganic materials, potassium titanate (PKT) and fibrous zirconia were identified as showing marked improvements in chemical compatibility. Mats of these materials and ceria were formed using organic binders, including Teflon and polypropylene. The most promising separator mats developed consisted of the base materials (either PKT, ceria powder, or zirconia powder) composited with a small percentage of Teflon powder which was formed into a fibrous network by repeated rolling treatments during processing. Three mat compositions using the fibrilated Teflon-bonded approach were produced for evaluation. Author

N69-16110*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EXPERIMENTAL EVALUATION OF OUTER CASE BLOWING OR BLEEDING OF SINGLE STAGE AXIAL FLOW COMPRESSOR. PART 3: PERFORMANCE OF BLOWING INSERT CONFIGURATION NO. 1
C. C. Koch and L. H. Smith, Jr. 22 Nov. 1968 53 p refs
(Contract NAS3-7618)
(NASA-CR-54589; GE-R68AEG318) Avail: CFSTI CSCL 10A

So that air could be injected at the tip for boundary layer control, a 1120 feet per second tip speed rotor having an aspect ratio of 4.5 and an inlet hub-tip radius ratio of 0.5 was equipped with a perforated outer casing. Testing was conducted with distorted as well as undistorted inlet flow, and overall and stalling performance were obtained for each inlet condition. For distorted inlet flow, rotating stalls began at the tip of the rotor, and the injection of boundary layer control air was effective in increasing stall margin. With undistorted inlet flow, rotating stall began at the pitchline for this rotor, and tip blowing did not produce significant improvements in stall margin. For part 1, see N67-12096; for part 2, see N68-32906. Author

N69-16379*# Westinghouse Electric Corp., Lima, Ohio.
INVERTER-CONVERTER PARALLEL OPERATION
G. W. Ernsberger, H. R. Howell, and J. L. Klingenberger
Washington NASA Jan. 1969 107 p refs
(Contract NAS3-2792)
(NASA-CR-1224) Avail: CFSTI CSCL 10B

Mathematical analysis of circuit operation for harmonic-neutralized, static inverters operating in parallel have been developed and experimentally verified. Inverters can be operated in parallel provided that: (a) all inverters operate at exactly the same frequency; (b) the internal voltages of all inverters are in phase at all times; (c) all nominal regulated output voltages are the same; and (d) circuit provisions in each inverter insure load division. Static converters can be operated in parallel provided that: (a) all converters have the same nominal regulated output voltage, and (b) circuit provisions are provided in each voltage regulator circuit to cause the converters to share load current. Author

N69-16422*# McDonnell-Douglas Co., Huntington Beach, Calif.
PARAMETRIC STUDY OF SPACE POWER SYSTEMS. VOLUME 1: SUMMARY Final Report
A. D. Tonelli et al. Nov. 1968 30 p refs
(Contract NAS2-4482)
(NASA-CR-73729; DAC-62303) Avail: CFSTI CSCL 22B

A summary is presented of the study methodology and significant results of the parametric study of space power systems. Included is a description of the study objectives and methodology; a listing of the power subsystems, systems, and mission constraints that were investigated; a description of the developed H-521 computer program indicating the flow network, examples of input and output data, and sensitivity analysis performed on a typical space power system using the H-521 program. Also included are recommendations of future work to increase the versatility and capability of the computer program. Author

N69-16423*# McDonnell-Douglas Co., Huntington Beach, Calif.
PARAMETRIC STUDY OF SPACE POWER SYSTEMS. VOLUME 2: TECHNICAL REPORT Final Report
A. D. Tonelli Nov. 1968 204 p refs
(Contract NAS2-4482)
(NASA-CR-73280; DAC-62304) Avail: CFSTI CSCL 22B

The results of the study effort are presented on the parametric study of space power systems. A description is included of the rationale used to select the power systems for investigation, a description of the guidelines and constraints used in the study, a

description of the methodology used in the analysis of the power systems, and a review of complete power systems characteristics and sensitivity analysis. Also presented is a description of the H-521 computer program developed, and a summary of power system technology readiness. Author

N69-16424*# McDonnell-Douglas Co., Huntington Beach, Calif.
PARAMETRIC STUDY OF SPACE POWER SYSTEMS. VOLUME 3: POWER SUBSYSTEM PARAMETRIC DATA
A. D. Tonelli Nov. 1968 308 p refs
(Contract NAS2-4482)
(NASA-CR-72381; DAC-62305) Avail: CFSTI CSCL 22B

The parametric data are presented that were used in performing the parametric study of space power systems. The information includes parametric data on power conversion subsystems, energy sources, heat rejection subsystems, power conditioning subsystems, energy storage, power distribution subsystems, and integration of the power system with the space vehicle. The parametric data are the baseline or reference data that were used in calculating the characteristics such as mass, volume, area, cost, and reliability of the various power systems, subsystems, and major components. Author

N69-16572*# Naval Ammunition Depot, Crane, Ind.
NASA SPACE CELL TEST PROGRAM Progress Report, Period Ending 31 Dec. 1968
C. G. Lynch 31 Dec. 1968 47 p refs
(NASA Order S-23404-G)
(NASA-CR-99216) Avail: CFSTI CSCL 10C

Evaluated is the test performance of various separator materials for silver zinc batteries. Cells are tested for constant-potential cycling, constant current, and charged standing. Cell voltages and currents are recorded at regular intervals after open circuit cell voltage readings. The purpose of these tests is to ascertain the applicability of zinc-oxygen cells to the space program and to determine their capability to deliver reliable power over a certain span of time. Tests are not yet concluded. G.G.

N69-16573*# AiResearch Mfg. Co., Phoenix, Ariz.
DESIGN AND FABRICATION OF THE BRAYTON CYCLE HIGH PERFORMANCE TURBINE RESEARCH PACKAGE Final Report
14 Feb. 1968 74 p
(Contract NAS3-9427)
(NASA-CR-72478; APS-5281-R) Avail: CFSTI CSCL 10A

Designed, fabricated, and tested is a turbine research package. The research package is aerodynamically identical to the turbine used in the NASA Brayton Rotating Units (BRU) to be delivered under the same contract. This turbine research package will be utilized for complete component performance evaluation. Author

N69-16654 Illinois Univ., Urbana.
A THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE GAMMA-ELECTRIC CELL
Henry Thomas Sampson (Ph.D. Thesis) 1967 179 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-8212

The gamma-electric cell (γ-EC) is a solid state device for the direct conversion of gamma radiation into electrical energy. Electric currents are produced by using electrodes to collect Compton electrons arising from the interaction of gamma photons with a dielectric. Theoretical and experimental investigations of both short circuit and high voltage operation are reported. A series of γ-EC's having various compositions and geometries were irradiated in the TRIGA Reactor and Co^{60} facilities. Both single and multielectrode cells containing either lucite, silicone, polystyrene, or epoxy were tested. Stable voltage outputs exceeding 10 kV were attained for several cells. A cell containing parallel electrodes separated by 1 inch thick sections of epoxy dielectric reached voltages between 15 and 19 kV during an 8 hour reactor irradiation at a gamma dose rate of 10 R/hr. Dissert. Abstr.

N69-16663*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
CASCADED THERMOELECTRIC TEST GENERATOR, PHASE 2 Quarterly Progress Report, 1 Sep.–30 Nov. 1968
30 Nov. 1968 8 p Prepared for JPL
(Contracts NAS7-100; JPL-952198)
(NASA-CR-73641; WANL-PR-(DDD)-004) Avail: CFSTI CSCL 10B

Progress on the design and fabrication of a cascaded SiGe/tubular PbTe thermoelectric test generator is presented. Primary emphasis during the period has been on the completion of detailed manufacturing drawings, on the initiation and partial completion of component fabrication, on the design and procurement of a multi-foil insulation package, and on thermal cycling tests of tantalum specimens coated with zirconia and alumina. Also included is a brief status summary of the major system components along with the modifications that have resulted from the detailed design study. Author

N69-16736*# Bendix Corp., Southfield, Mich. Research Labs.
HYDRAULIC FLUID INTERACTION SERVOVALVE
T. A. Phillips and A. Blatter [1967] 142 p refs
(Contract NAS8-11928)
(NASA-CR-98224; Rept-4428) Avail: CFSTI CSCL 13G

This program demonstrated the feasibility of using fluidic vortex valves as the fluid control elements in a hydraulic servoactuator control system. The vortex valves were incorporated into a completely new servovalve concept and physically designed into a package interchangeable with an existing spool-type servovalve. The vortex servovalve offers the advantages of lower cost because of few precision parts and good contamination tolerance due to large flow channels. In addition, the vortex valve has significantly different dynamic characteristics than spool-type servovalves. Analysis has shown that the dynamic pressure feedback compensation now required with some engine gimbaling servoactuators may not be required if a vortex servovalve is used. High flow consumption of the vortex servovalve is compatible with recent trends toward using fuel as the hydraulic servosystem fluid. Author

N69-16746*# Thermo Electron Engineering Corp., Waltham, Mass.
APPLIED THERMIONIC RESEARCH Quarterly Progress Report, 4 Jun.–4 Nov. 1968
D. Lieb, F. Rufeh, M. Shaw, and L. van Someren 4 Nov. 1968 73 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952184)
(NASA-CR-73637; TE-4092/3-53-68; QPR-3) Avail: CFSTI CSCL 10B

The mass spectrometric system for the investigation of electro-negative additives was modified and data were obtained from a cesium oxide capsule at temperatures up to 240°C. The emission characteristics of a vapor-deposited tungsten emitter with a molybdenum collector were investigated in a variable-spacing converter. The set of data obtained is particularly useful for comparison with the results of theoretical analysis and for studies of interrelationships between the various converter parameters, since it includes work function measurements and variable spacing data as well as cesium pressure families. The data were used to investigate the dependence of the voltage drop on the product of cesium pressure and interelectrode spacing Pd, cesium pressure P

and ion richness β. At constant values of Pd and β, a dependence on cesium pressure was observed. Author

N69-16772 Oklahoma State Univ., Stillwater.
A NEW APPROACH TO HIGH-PRESSURE, HIGH-TEMPERATURE HYDROGEN-OXYGEN FUEL-CELL AND ELECTROLYSIS-CELL DESIGN
Hansell Jack Allison (Ph.D. Thesis) 1967 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-8357

The objective of this study is to present an approach to high-pressure, high-temperature fuel-cell and electrolysis-cell electrode design which is based on the theory of conformal transformations. Electrode configurations resulting from a conformal transformation of the type considered in this study have electrostatic field characteristics similar to those associated with conventional parallel plate electrodes. Fuel cells and electrolysis cells which are operated at high pressures and temperatures can have electrical characteristics which are superior to those of cells which are operated at lower pressures and temperatures. The conformal transformation approach to electrode design can lead to electrolysis cells which have extremely high energy density and efficiency parameters. Fuel cells constructed from this approach to cell design can have significant electrical parameters. Dissert. Abstr.

N69-16773# Case Western Reserve Univ., Cleveland, Ohio.
FLUERICS: 24. DEVELOPMENT OF A TWO-STATE FLUERIC POWER AMPLIFIER
Christopher Michael Carlin Jul. 1968 68 p refs
(Contract DA-49-186-AMC-79(D))
(AD-679021; HDL-79-3) Avail: CFSTI CSCL 13/7

A two-state, two-state power amplifier has been built. The preamplifier stage is a bistable wall attachment amplifier, the power stage a vortex amplifier. A method of graphical analysis is given to describe the static interconnection of the two dissimilar elements. The static characteristics of the device show a turndown ratio (the ratio of maximum vortex amplifier outlet flow to the total flow which must be supplied to the hybrid amplifier in the standby condition) of 5.5:1 with a ratio of vortex amplifier supply pressure to input control pressure of 4:1. Author (TAB)

N69-16851# Office of Naval Intelligence, Washington, D. C. Translation Div.
MIXED KINETICS IN A HIGH TEMPERATURE FUEL CELL [K VOPROSY O SMESHANNOY KINETIKE V. VYSOKOTEMPERATURNOM]
Yu. A. Popov et al 3 Sep. 1968 8 p refs Transl. into ENGLISH from Elektrokhimiya (Moscow), v. 4, no. 3, Mar. 1968 p 294-298
(AD-679310; NIC-Trans-2679) Avail: CFSTI CSCL 10/2

The report studies the diffusion and conductivity of the gas phase in a three-phase model of the individual pore in a high-temperature fuel cell. TAB

N69-16860*# Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center.
HEAT STERILIZABLE, IMPACT RESISTANT CELL DEVELOPMENT Quarterly Report, 1 Apr.-30 Sep. 1968
G. W. Bodamer, ed. 20 Dec. 1968 66 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951296)
(NASA-CR-73644) Avail: CFSTI CSCL 10C

Investigations into the causes of capacity loss following heat sterilization were continued. Polyphenylene oxide (PPO) cell cases sealed with epoxy adhesives, the phenomenon seems especially bad in small size cells. Cells assembled in Teflon inserts contained in nickel bomb do not show capacity loss following heat sterilization even after epoxies, or PPO, or other organic components are deliberately included. The latter observations suggested that the cause may be more mechanical than chemical. Preliminary cycling, before sealing and sterilizing in PPO cases, offers the possiblity of checking cell performance before flight. By careful discharge to assure no remaining zinc metal, pressure build-up during sterilization was avoided, and under certain conditions capacities are satisfactory. A battery made up of 5 amp-hr sealed cells was heat sterilized and performed satisfactorily after the test drop in which the impact was 2800 g. For larger size cells, one-inch wide plates reinforced with sheet metal cores were designed. Author

N69-16891*# Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.
DEVELOPMENT OF LITHIUM DIFFUSED RADIATION RESISTANT SOLAR CELLS Quarterly Report
P. Payne 15 Jan. 1969 14 p Prepared for JPL
(Contracts NAS7-100; JPL-952247)
(NASA-CR-73643; QR-3; Rept-9) Avail: CFSTI CSCL 10B

Research work on evaporated lithium as a diffusion source continued. Sintering of P/N cells with and without lithium was also studied. Particular emphasis was placed on those cells without lithium in order to isolate the effect of sintering a TiAg contact on a P/N cell from the effect of heat treatment on lithium diffused cells. Author

N69-16972*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
DESIGN AND DEVELOPMENT OF A BRUSHLESS, DIRECT-DRIVE SOLAR-ARRAY REORIENTATION SYSTEM Final Report: Phase 1
R. D. Jessee Jun. 1968 70 p refs
(Contract NAS5-10459)
(NASA-CR-73710) Avail: CFSTI CSCL 22B

Effort has been directed toward developing a controller for a brushless, direct-drive, single-axis solar array reorientation system for earth-pointed, passively-stabilized spacecraft. A control system has been designed and breadboard circuits have been built and tested for performance. The controller is designed to take over automatic control of the array on command after the spacecraft is stabilized in orbit. The controller will orient the solar array to the sun vector and automatically track to maintain proper orientation. So long as the orbit is circular, orientation toward the sun is maintained even though the spacecraft goes into the shadow of the earth. Particular attention was given in the design to limit reaction between the array and the spacecraft. The control system is capable of reorienting a simulated solar array having an inertia of 5 to 10 slug feet square from any position, smoothly within a three-minute period. Author

N69-16974*# Tyco Labs., Inc., Waltham, Mass.
DEVELOPMENT OF UNIFORM AND PREDICTABLE BATTERY MATERIALS FOR NICKEL CADMIUM AEROSPACE CELLS Quarterly Report, 8 May-7 Aug. 1968
7 Aug. 1968 47 p refs
(Contract NAS5-11561)
(NASA-CR-98627; QR-1) Avail: CFSTI CSCL 10C

The development of more reliable nickel cadmium batteries for aerospace application is dependent on improvements in the uniformity and reproducibility of the battery plates. This program investigates the sintering and plaque filling processes associated with plate manufacture in order to improve these factors. The first report presents a survey of the literature pertaining to the manufacture of nickel cadmium battery plates and examines present industrial practices in this field, particularly quality control. The general conclusions are that the industry, though manufacturing a successful commercial product, is not geared to the production of high quality plates for aerospace application. A preliminary analysis

of the uniformity of physical characteristics of several samples of the commercial nickel powder, exclusively used in battery plate manufacture, indicates variations in bulk density, surface area and particle size distribution. Author

N69-16975*# Melpar, Inc., Falls Church, Va.
THE DESIGN AND DEVELOPMENT OF A LOW TEMPERATURE BALLOON BATTERY Phase 1 Final Report, 22 May–6 Aug. 1968
5 Aug. 1968 38 p refs
(Contract NAS5-11557)
(NASA-CR-73711) Avail: CFSTI CSCL 10C

Solar energy transmission measurements of various plastic films used as solar energy collecting arrays are investigated. Heat losses were estimated and a design was evolved, serving as solar energy transmitting and heat insulating array. This array or enclosure was tested using several solar thermal storage materials of the heat of fusion type. The battery temperature was stabilized in the presence of solar heat during the daytime, using the stored heat during nights. An array of 8 air-spaced Teflon FEP film transmits 68% solar radiation, while its heat insulating value is U = 0.15 or better. Heat storage materials were tested, melting around −23°C and −25°C. These have been subjected to simulated night-time tests, indicating that the desired battery temperature (−30°C) can be maintained for more than 12 hours. Compared with water–ice a volume reduction of 70% is indicated, while the weight reduction is approximately 40%. Author

N69-16997*# Fairchild Hiller Corp., Germantown, Md. Space and Electronics Systems Div.
POSITIVE DEPLOYABLE SOLAR ARRAY DEVELOPMENT PROGRAM—PHASE 3 Final Report
Jul. 1968 90 p refs
(Contract NAS5-9658)
(NASA-CR-73736; REPT-815-00101-FR) Avail: CFSTI CSCL 10B

Flight qualification data are presented on a prototype deployable solar array (DSA) unit consisting of two flexible, back-to-back substrates mounted on synchronized rollers. The optimum modular array design was achieved by considering the combinations of materials used in the prototype, and evaluating the resultant designs through analysis and development tests. The module consists of solar cells, coverglasses, substrate, electrical wiring, and mechanical interface. The criteria for each are stated, and test details are given. The problems involved in redesigning the extension linkage of the prototype deployment mechanism to facilitate assembly and replacement are discussed. Tests were also conducted to determine the natural frequency of the DSA in each of the following modes: normal to substrate, parallel to substrate, and torsional (about the central axis of the scissors assembly). Various methods of simultaneously deploying two arrays were studied, along with methods of orienting flexible arrays. M.G.J.

N69-17037*# Naval Ammunition Depot, Crane, Ind.
NASA SPACE CELL TEST PROGRAM Monthly Progress Report, 1–31 Dec. 1968
C. G. Lynch 31 Dec. 1968 17 p refs
(NASA Order W-11252-B)
(NASA-CR-99215) Avail: CFSTI CSCL 10C

The status of the spacecraft cell testing program is reported. Computer listings are included for each type of cell being tested and its test parameters, as well as those for which testing was completed. Symbolic terminology found in the listings is defined. A.C.R.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N69-16102*# Public Health Service, Phoenix, Ariz. Planetary Quarantine Unit.
SERVICES PROVIDED IN SUPPORT OF THE PLANETARY QUARANTINE REQUIREMENTS OF NASA Progress Report, Oct. 1–Dec. 31, 1968
N. Petersen Jan. 1969 20 p
(NASA Order R-137)
(NASA-CR-99221; PR-24) Avail: CFSTI CSCL 06M

Summary data are presented on the experiments undertaken to evaluate the vacuum probe as a surface sampler for microbial contamination, to determine dry heat resistances of bacterial spores, and to assess the level of microbial contamination on the Apollo spacecraft. Graphs and tables are included to show: (1) comparative dry heat survivor curves of spore isolates, CK-4 and G-2, sporulated on TAM and recovered with TSA and supplemented TSA; (2) comparative dry heat survivor curves of spore isolate G-2 sporulated on AK #2 and recovered with TSA and supplemented TSA; (3) survival of various bacterial populations exposed to filtration, drying, and airflow; (4) comparative recovery of spores by TSA and TSA supplemented with 0.2% yeast extract and 0.1% soluble starch; (5) microbial contamination detected on Apollo command modules (cm), the interior surfaces of the instrument unit, the Saturn S-4B, and the lunar modules(um); (6) levels of microbial contamination detected on the exterior surfaces of the LM ascent and descent stages; (7) mold contamination detected on surfaces of the Apollo cm and lm; (8) types of aerobic mesophilic microorganisms isolated from the Apollo CM and LM; and (9) effect of extended incubation on recovery of molds from space hardware surfaces. M.G.J.

N69-16103*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
I-123 PRODUCTION BY THE Sb-121 (α, 2n) I-123 METHOD
Vincent J. Sodd (Natl. Center for Radiological Health, Cincinnati, Ohio) and James W. Blue Washington 1969 17 p refs
(NASA-TM-X-52534) Avail: CFSTI CSCL 07E

A cyclotron technique is described for producing high purity ^{123}I using the ^{121}Sb (α, 2n) ^{123}I method. This isotope is considered as an ideal radioisotope of iodine for low exposure in vivo measurements, and the reasons for this judgement are discussed along with the theoretical considerations. Details are given on the chemical procedures used to isolate the iodine products, and on those used to recover the enriched target material for subsequent use. Some typical decay spectra of an iodine fraction which was chemically separated by distillation are depicted. The yield of radioiodine products isolated from a 50 mg ^{121}Sb target bombarded for a total charge of 0.37 coulombs is tabulated. Also shown for each product are its half-life, the energy of the gamma ray peak used in the spectral analysis, and the abundance value of that gamma ray used in the yield calculations. M.G.J.

N69-16169 Minnesota Univ., Minneapolis.
ELECTRON MICROSCOPY OF THE CENTRAL NERVOUS SYSTEM: EXAMINATION OF SELECTED STRUCTURES, THEIR RELATIONSHIP TO FUNCTIONAL MODELS AND TO PROBLEMS OF PREPARATION ARTIFACT
Charles Heiner Good (Ph.D. Thesis) 1967 557 p
Avail: Univ. Microfilms: HC $25.20/Microfilm $7.10 Order No. 68-7318

Improvement of methods for the electron microscopic (EM) study of the central nervous system (CNS) are needed. Inconsistencies

in the EM description of the neuroglia, and slight relationship to neurohistology, neurochemistry and electro-physiology are noted in the EM literature. Perfusion of the rat CNS was done with glutaraldehyde as a killing agent and primary fixative. This fixative was compared at the macroscopic, light microscopic and EM level with OsO_4 and formalin perfused tissue, and with immersion fixed tissue. Secondary fixation was with OsO_4. Embedding was done in Vestopal. Methods for selecting small CNS loci were devised. Observations were made which are of interest to and suggest directions for EM investigation related to neuropathology, neurochemistry, electrophysiology and psychobiology. Criteria for the EM identification of the neuroglial cell types is emphasized. Dissert. Abstr.

N69-16204# Human Engineering Labs., Aberdeen Proving Ground, Md.
SHORT-TERM MEMORY: AN ANNOTATED BIBLIOGRAPHY
Dennis F. Fisher and Harry F. Wiggins Aug. 1968 152 p
(AD-678546) Avail: CFSTI CSCL 5/10

The bibliography is an annotated compilation of 435 references dealing with short-term memory. The period of time from 1959 to June 1968 (present) has accounted for the majority of research in this area, and in accord with this, most of the references included herein are from this period. The included references are arranged in alphabetical order by author. An alphabetical index of pertinent parameters of investigation as well as topics of interest is also provided. Author (TAB)

N69-16247# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF TOTAL VERTICAL VIBRATION ON FUNCTIONAL STATE OF THE VESTIBULAR APPARATUS IN GUINEA PIGS
Z. I. Apanasenko 8 Feb. 1968 12 p Transl. into ENGLISH from the book "Vliyaniye Ioniziruyushchikh Izlucheniy i Dinamicheskikh Faktorov na Funktsii Tsentral'noy Nervnoy Sistemy. Voprosy Kosmicheskoy Fiziologii" Moscow, Izd. AN SSSR, 1964 p 76-84
(AD-678782; FTD-HT-23-1474-67) Avail: CFSTI CSCL 6/16

Twice-repeated exposure to vibration (15 min each time) causes a statistically reliable increase in spontaneous electric activity of the hind leg muscles at relative rest in guinea pigs. Such vibration will also activate the response to adequate stimulation of the vestibular apparatus, as recorded by an electromyograph. The latency of reaction is reduced, while the aftereffect is prolonged. These changes persist through a 5-7 day period following vibration. No statistically reliable changes are noted affecting the general condition of the animal or the peripheral blood composition. Author (TAB)

N69-16250# Yeshiva Univ., New York. Graduate School of Humanities and Social Sciences.
SUPPRESSION AND FUSION IN STEREOPSIS Annual Report
Lloyd Kaufman Aug. 1968 48 p refs
(Contract DADA17-67-C-7162)
(AD-679217) Avail: CFSTI CSCL 6/16

Contents: Amplitude modulation of brain waves: The waveform and spectrum of the high-frequency visual evoked response. TAB

N69-16332# Joint Publications Research Service, Washington, D. C.
SPACE BIOLOGY AND MEDICINE, VOLUME 2, NUMBER 5, 1968
14 Jan. 1969 151 p refs Transl. into ENGLISH from Kosmich. Biol. i Med. (Moscow), v. 2, no. 5 1968
(JPRS-47249) Avail: CFSTI

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2. PATHOMORPHOLOGICAL PECULIARITIES OF RADIATION DISEASE IN ANIMALS IRRADIATED BY HIGH-ENERGY PROTONS V. V. Shikhodyrov et al p 10-14 refs (See N69-16334 06-04)

3. CHANGES IN THE RADIATION EFFECT IN PLANTS EXPOSED TO SPACECRAFT FACTORS D. F. Gertsuskiy et al p 15-18 refs (See N69-16335 06-04)

4. RADIOSENSITIVITY OF POTATOES TO GAMMA-RAY AND PROTON IRRADIATION IMPARTED TO TUBERS AND EYES BEFORE PLANTING Y. I. Shaydorov et al p 19-26 refs (See N69-16336 06-04)

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6. HISTOLOGICAL STUDY OF THE INTERNAL ORGANS OF MICE EXPOSED TO A HYPEROXIC ATMOSPHERE FOR 20 DAYS V. V. Portugalov et al p 35-39 refs (See N69-16338 06-04)

7. ELECTRON MICROSCOPE OBSERVATIONS OF CHANGES IN THE LUNGS OF RATS AFTER REPEATED EXPOSURE TO PURE OXYGEN V. N. Vinogradov et al p 40-45 refs (See N69-16339 06-04)

8. EFFECT OF HIGH OXYGEN CONCENTRATIONS ON THE INDUCED POTENTIAL OF THE CORTICAL OPTIC ZONE AND SOME SUBCORTICAL ZONES L. V. Kalyuzhnyy p 46-56 refs (See N69-16340 06-04)

9. CHANGES IN THE INTESTINAL MICROFLORA OF RATS CAUSED BY PROTEIN-FREE DIETS N. N. Lizko et al p 57-62 refs (See N69-16341 06-04)

10. ROLE OF THE THYROID GLAND IN CHANGES IN THE RESISTANCE AND MYOGLOBIN CONTENT OF SKELETAL MUSCLES OF "LOWLAND" AND HIGH-ALTITUDE ACCLIMATIZED WHITE RATS A. B. Botombekova p 63-69 refs See N69-16342 06-04)

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13. EFFECT OF PROLONGED BEDREST ON CEREBRAL BIOPOTENTIALS OF HEALTHY SUBJECTS B. N. Petukhov et al p 86-94 refs (See N69-16345 06-04)

14. USE OF MEASURED CORIOLIS ACCELERATIONS IN VESTIBULOMETRY R. R. Galle et al p 95-104 refs (See N69-16346 06-04)

15. BIOMECHANICS OF THE RESPIRATORY ACT DURING LONG-TERM ACCELERATIONS (AN X-RAY STUDY) K. I. Murakhovskiy p 105-114 refs (See N69-16347 06-04)

16. USE OF HIGH TEMPERATURES AS A FUNCTIONAL-DIAGNOSTIC TEST A. N. Azhayev et al p 115-121 refs (See N69-16348 06-04)

17. AUTOMATIC PROCESSING OF AN ECG (ELECTROCARDIOGRAM) REGISTERED DURING SPACE FLIGHT V. A. Krylov et al p 122-130 refs (See N69-16349 06-04)

18. BIOCHEMICAL INDICES OF THE REACTION OF FLIERS TO COMPLEX FLIGHT CONDITIONS I. G. Dlusskaya et al p 131-137 refs (See N69-16350 06-05)

N69-16333# Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL VERIFICATION OF ADMISSIBLE RADIATION DOSES DURING PROLONGED SPACE MISSIONS (CHRONIC EXPERIMENTS ON DOGS)

Yu. G. Grigoryev et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 1-9 refs (See N69-16332 06-04)
Avail: CFSTI

A chronic experiment was carried out for the purpose of determining the admissible radiation doses during space missions. The experiment involved 150 dogs divided into several groups which were exposed to chronic irradiation in doses of 25 to 150 rem per year or to chronic irradiation aggravated by acute irradiation in doses of 10-50 rem. The results accumulated during the first year of exposure are presented. Regular examinations of the animals involving clinical, morphological, physiological, immunological and biochemical tests suggests that a year-long exposure of animals to irradiation at the stipulated doses has produced no significant pathological changes in their bodies. Author

N69-16334# Joint Publications Research Service, Washington, D. C.
PATHOMORPHOLOGICAL PECULIARITIES OF RADIATION DISEASE IN ANIMALS IRRADIATED BY HIGH-ENERGY PROTONS
V. V. Shikhodyrov et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 10-14 refs (See N69-16332 06-04)
Avail: CFSTI

Test dogs were irradiated with 126- and 510-MeV protons, being exposed to single and repeated irradiations with doses of 250 and 700 rad. Certain peculiarities in the pathomorphological picture of the radiation disease were found. They included hemorrhagic diathesis and disorders of the hemopoietic and nervous systems. Changes developing at long intervals after the occurrence of the disease was detected. Author

N69-16335# Joint Publications Research Service, Washington, D. C.
CHANGES IN THE RADIATION EFFECT IN PLANTS EXPOSED TO SPACECRAFT FACTORS
D. F. Gertsuskiy et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 15-18 refs (See N69-16332 06-04)
Avail: CFSTI

This paper presents data indicating changes in the ascorbic acid content in an onion set induced by subjecting the bulbs to gamma irradiation or by spaceflight factors. Exposure of plants to low doses of ionizing radiation and spaceflight factors imparted separately resulted in an increase in the vitamin C content in the onion top. In the case of a cumulative effect of these stress agents spaceflight factors reduced the stimulating effect of radiation and reduced the ascorbic acid content. Author

N69-16336# Joint Publications Research Service, Washington, D. C.
RADIOSENSITIVITY OF POTATOES TO GAMMA-RAY AND PROTON IRRADIATION IMPARTED TO TUBERS AND EYES BEFORE PLANTING
Yu. I. Shaydorov et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 19-26 refs (See N69-16332 06-04)
Avail: CFSTI

This paper gives the results of a study of the effect of preplanting irradiation of potato tubers and eyes (isolated with a small endosperm portion) with Co^{60} gamma rays and 620-MeV protons on plant growth and development. The effect of irradiation on the eyes was found to be lower than on the tubers, the inhibitory effect of proton radiation being greater than that of gamma rays. Author

N69-16337# Joint Publications Research Service, Washington, D. C.
EFFECT OF HIGH OXYGEN CONCENTRATIONS ON THE ANIMAL BODY
N. A. Agadzhian et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 27-34 refs (See N69-16332 06-04)
Avail: CFSTI

Experiments were performed on white rats and mice to study the effect of an artificial atmosphere (53% O_2 at 760 mm Hg) on external respiration, pulmonary gas exchange, tolerance to acute hypoxia, oxidative phosphorylation in cerebral tissues, immunological indices and morphological structure of their internal organs. Certain changes in these parameters were detected. The functional indices returned to normal levels during the aftereffect period. Author

N69-16338# Joint Publications Research Service, Washington, D. C.
HISTOLOGICAL STUDY OF THE INTERNAL ORGANS OF MICE EXPOSED TO A HYPEROXIC ATMOSPHERE FOR 20 DAYS
V. V. Portugalov et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 35-39 refs (See N69-16332 06-04)
Avail: CFSTI

Histological methods were applied to study the lungs, heart, liver, kidneys, spleen, testes, thymus and inguinal lymph nodes of mice that were exposed for 20 days in an atmosphere with a total pressure of 760 mm Hg and a partial pressure of 304 mm Hg. No significant changes were observed in the lungs, heart, kidneys and testes. In the liver there was a moderate proliferation of histiocyte and myeloid elements around vessels. In the lymphoid organs there was an increased lysis of lymphocytes and appearance of a large number of macrophages which could phagocytize nuclear detritus. These lesions were observed in light centers of lymphoid follicles of the spleen, lymph nodes and thymic cortex. In the red pulp of the spleen there was a pronounced proliferation of reticular cells and blasts. Author

N69-16339# Joint Publications Research Service, Washington, D. C.
ELECTRON MICROSCOPE OBSERVATIONS OF CHANGES IN THE LUNGS OF RATS AFTER REPEATED EXPOSURE TO PURE OXYGEN
V. N. Vinogradov et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 40-45 refs (See N69-16332 06-04)
Avail: CFSTI

It was demonstrated that the average life expectancy of rats exposed to a pure oxygen atmosphere after eight repeated exposures to pure oxygen at normal pressure at intervals of two or three days was similar to that of control animals (50% of which died on the third day). After four exposures of 48 hours duration with five-day intervals the resistance of rats to pure oxygen significantly increased (50% of the animals died on the tenth day). The authors conclude that the animals develop their tolerance to toxic oxygen exposure not as a result of physiological adaptation but due to pathological reconstruction of the blood-air barrier which involves thickening of the septal spaces of endothelial and alveolar cells and narrowing of capillary space, which impairs oxygen diffusion. Author

N69-16340# Joint Publications Research Service, Washington, D. C.
EFFECT OF HIGH OXYGEN CONCENTRATIONS ON THE INDUCED POTENTIAL OF THE CORTICAL OPTIC ZONE AND SOME SUBCORTICAL ZONES
I. V. Kalyuzhnyy *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 46-56 refs (See N69-16332 06-04)
Avail: CFSTI

Unanesthesized rabbits exposed to 96% O_2 at atmospheric pressure exhibited a three-stage change in potential induced by a light flash: (1) an increase in the secondary discharge (1st-2nd day); (2) replacement of the secondary discharge by unstable

fluctuations, the primary response being maintained (2nd-3rd day); and (3) disappearance of the induced potential, accompanied by a gradual increase in excitation of the subcortical non-specific system. Animals exposed to 53% O_2 exhibited: (1) an increase in the secondary discharge (2nd-5th day); (2) elongation of the slow negative surface wave (6th-8th day); and (3) maintenance of the primary response to the induced potential (9th-10th day), accompanied by an initial excitation and a decrease in the subcortical nonspecific system. Author

N69-16341# Joint Publications Research Service, Washington, D. C.

CHANGES IN THE INTESTINAL MICROFLORA OF RATS CAUSED BY PROTEIN-FREE DIETS

N. N. Lizko et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 57-62 refs (See N69-16332 06-04)
Avail: CFSTI

It has been established that white rats maintained on protein-free diets exhibited changes in the composition of intestinal microflora which involved a decrease of lactic acid bacteria and an increase in spore-forming bacteria. Subsequent feeding of the test animals with diets containing various proteins (18%) resulted in normalization of the composition of intestinal microflora. Author

N69-16342# Joint Publications Research Service, Washington, D. C.

ROLE OF THE THYROID GLAND IN CHANGES IN THE RESISTANCE AND MYOGLOBIN CONTENT OF SKELETAL MUSCLES OF "LOWLAND" AND HIGH-ALTITUDE ACCLIMATIZED WHITE RATS

A. B. Botombekova *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 63-69 refs (See N69-16332 06-04)
Avail: CFSTI

The role of the thyroid gland in the development of adaptation processes at the tissue level was studied during the acclimatization of animals to altitude (Tuya-Ashu Pass, 3,200 m). The resistance of skeletal muscles in *in vitro* experiments and their myoglobin content was studied. The red blood picture was also examined. A thyroidectomy was shown to increase the resistance of skeletal muscles. This is considered a passive reaction due to a reduced basal metabolism. The myoglobin content was found to decrease. The altitude adaptation of test animals was accompanied by a further increase in the resistance of skeletal muscles caused by an increased myoglobin content. This indicates that a thyroidectomy does not impair the formation of active adaptive reactions at the tissue and cell levels during the altitude adaptation of animals. Author

N69-16343# Joint Publications Research Service, Washington, D. C.

DYNAMICS OF FORMANTS IN THE SPEECH SPECTRUM AS AN OBJECTIVE INDICATOR FOR DISCRIMINATING POSITIVE AND NEGATIVE EMOTIONS

A. G. Tishchenko *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 70-78 refs (See N69-16332 06-04)
Avail: CFSTI

A thorough study of the formant structure of the sounds "o, u, yu, a", in whose formation the lips are involved, is an aid not only in revealing emotional stress but also for discriminating positive and negative emotions. During a negative emotion the first formant increases with an increase in emotional stress, the second varies in its character and the third decreases. All the formants increase in the case of a positive emotion. The pattern of the dynamics of formants is in good agreement with the acoustic theory of speech formation. Studies of the dynamics of formants in the speech spectrum in relation to autonomic indices provide a valuable method for evaluating emotional stress in pilots and cosmonauts. Author

N69-16344# Joint Publications Research Service, Washington, D. C.

CHANGES IN CARDIAC ACTIVITY DURING PROLONGED HYPOKINESIA (DATA FROM VECTOR ANALYSIS)

B. A. Korolov *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 79-85 refs (See N69-16332 06-04)
Avail: CFSTI

It is known that long-persisting hypokinesia causes certain changes in the electrocardiogram: a decreased amplitude of the R and T waves, an inversion of the ST segment and T wave and an increased U wave. For the purpose of determining the nature of the changes the integral QRS and T vectors and the ventricular gradient in the frontal plane were studied for healthy male test subjects restricted to 70-day bed confinement. The changes in vectors, ventricular gradient and angular distances were less in test subjects who regularly performed physical exercises during the bed-rest experiment. The vector analysis revealed that the secondary nature of the changes in the electrocardiogram appear to be related to variations in myocardial metabolism. Author

N69-16345# Joint Publications Research Service, Washington, D. C.

EFFECT OF PROLONGED BEDREST ON CEREBAL BIOPOTENTIAL OF HEALTHY SUBJECTS

B. N. Petukhov et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 86-94 refs (See N69-16332 06-04)
Avail: CFSTI

A 62-day bedrest experiment was conducted with six healthy male test subjects; three of these performed physical exercises of a known force. The test subjects underwent electroencephalographic studies. The results are presented in relation to the determination of cortical responses to indifferent stimuli and changes in the frequency and amplitude of potentials. At later stages in the experiment there was a gradual shift of cortical responses toward a slow frequency and rate of formation. These changes give evidence of an increasing predominance of the inhibition process induced by bedrest. It was noted that the changes were more distinct in subjects performing no physical exercises. Author

N69-16346# Joint Publications Research Service, Washington, D. C.

USE OF MEASURED CORIOLIS ACCELERATIONS IN VESTIBULOMETRY

R. R. Galle et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 95-104 refs (See N69-16332 06-04)
Avail: CFSTI

A new method for examining the vestibular function is described. The method is based on the use of Coriolis accelerations of a known increasing magnitude as a stimulus. The accelerations develop while the test subject, bent forward at 60-70°, straightens up, the chair rotating at velocities of 15, 30, 60 and 120°/sec and the Coriolis accelerations being 0.1, 0.2, 0.4 and 0.8 m/sec^2 respectively. The method makes it possible to construct curves of vestibular analyzer excitability which help to evaluate its functional state. Results of examinations of 20 male test subjects ages 24-37 made using this method are presented. It is emphasized that the described method has certain advantages over currently used tests, including Coriolis accelerations as a stimulus. It is recommended that the method be used as a vestibular test in special examinations. Author

N69-16347# Joint Publications Research Service, Washington, D. C.

BIOMECHANICS OF THE RESPIRATORY ACT DURING LONG-TERM ACCELERATIONS (AN X-RAY STUDY)

K. I. Murakhovskiy *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 105-114 refs (See N69-16332 06-04)
Avail: CFSTI

Using X-ray studies it was found that exposure of man to long-term accelerations of different directions results in peculiar changes of the topographic and anatomic relationships of toracic organs. These changes play an important role in determining disorders in the biomechanics of the respiratory act. Among them the most important are deformations of the rib cage of the thorax and changes in the configuration and level of the diaphraghm. The principal changes in the biomechanics of the respiratory act involve the following events. During exposure to relatively low accelerations (pelvis-to-head accelerations of 4 g and back-to-chest accelerations of 6 g) the respiratory amplitude of the diaphragm and ribs increases in comparison with the initial level (up to 50%). During exposure to accelerations of greater magnitude these indices show a relative and then an absolute decrease. Author

N69-16348# Joint Publications Research Service, Washington, D. C.

USE OF HIGH TEMPERATURES AS A FUNCTIONAL DIAGNOSTIC TEST

A. N. Azhayev et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 115–121 refs (See N69-16332 06-04)
Avail: CFSTI

Various high temperatures have been used as a provocative test during the training of cosmonauts. Thermal studies were performed on test subjects wearing special suits which reduced the thermal stress, making it nonuniform. The purpose of the experiments was to select the temperature level that could help to reveal physiological changes and shorten the test. Experiments were performed on unclothed test subjects in a thermal chamber at temperatures of 40, 60, 70 and 80°C. Heat exchange, cardiovascular system indices and biochemical indices of the blood and urine were analyzed. The results demonstrated that relatively slow (40-60 min) and distinct changes in physiological functions occurred at 60°C; this temperature can be recommended as a provocative thermal test. Mechanocardiographic examinations and biochemical analyses of the blood and urine are sufficiently informative to be used in the evaluation of the tolerance of cosmonauts to high temperatures. Author

N69-16349# Joint Publications Research Service, Washington, D. C.

AUTOMATIC PROCESSING OF AN ECG (ELECTROCARDIOGRAM) REGISTERED DURING SPACE FLIGHT

V. A. Krylov et al *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 122–130 refs (See N69-16332 06-04)
Avail: CFSTI

It is shown that the currently used methods of discriminating ECG shapes by comparing the record with standard curves and subsequent processing on computers requires high-capacity memory units and much computation time. For this reason a method of extreme formalization has been proposed. The method makes it possible to represent the ECG shape as the sum total of figures corresponding to positive and negative extrema as well as to the isoline. In this case each standard curve is described by one number placed in one computer cell; this provides a significant expansion of the memory. The method can be recommended for automatic ECG processing on computers as well as for logical reduction of the information to be transmitted by narrow-band channels. Algorithms for automatic ECG processing are presented. Author

N69-16427# Johns Hopkins Univ., Baltimore, Md.

EFFECT OF HYPOXIA ON LEARNED AND MOTOR RESPONSES: PHARMACOTHERAPEUTIC APPROACHES TO HYPOXIA

Stephen A. Weinstein and Zoltan Annau Nov. 1968 38 p
(Contract DA-49-193-MD-2726)
(AD-679226) Avail: CFSTI CSCL 6/5

Several types of investigations were carried on which can be categorized as follows: (1) The effects of carbon dioxide and/or carbonic anhydrase inhibition on performance and neural reactivity in low oxygen environments. (2) The effects of carbon dioxide and/or carbonic anhydrase inhibition on blood gases and acid-base balance in low oxygen environments. (3) The effects of motivation on performance in low oxygen environments. (4) The effects of past experience in low oxygen upon performance in subsequent exposures. (5) The effects of schedules of reinforcement on performance in low oxygen. (6) The conditionability of the deleterious effects of hypoxia, i.e. the association of previously neutral environmental stimuli with the deleterious effects of hypoxia. Author (TAB)

N69-16506*# Bellcomm, Inc., Washington, D. C.

PROBLEMS IN RADIATION DOSE CALCULATIONS IN SPACECRAFT. PART 1: ELECTRONS

J. S. Ingley 23 Aug. 1968 45 p refs
(Contract NASw-417)
(NASA-CR-99263; TM-68-1011-3) Avail: CFSTI CSCL 06R

The problem of calculating the radiation dose in earth orbit produced by energetic electrons and their associated bremsstrahlung is considered. Two methods of electron dose calculation are described, and areas where improvement could be made in either input data or calculational techniques are pointed out. It is concluded that bremsstrahlung calculations are sufficiently accurate for present purposes but that additional Monte Carlo calculations of electron penetration of thick shields (thickness greater than 70% of the electron range) are needed for accurate electron dose calculations. For the 250 nautical mile orbit phase of Apollo Mission E, present calculations predict an electron dose of 2.2 rad/day in the lunar module and .012 rad/day in the command module. This assumes the predicted decay rate of the artificially injected Starfish electrons is correct. These doses are approximately a factor of two higher than results obtained with earlier Monte Carlo transmission data. Author

N69-16536*# Michigan Univ., Ann Arbor. Human Performance Center.

A BIBLIOGRAPHY OF RESEARCH ON BEHAVIORAL DECISION PROCESSES TO 1968

Ward Edwards Jan. 1969 99 p refs
(Grant NGR-23-005-171; Proj. 08901)
(NASA-CR-99268; Memo-7; Rept-08901-1-M) Avail: CFSTI CSCL 05J

An extensive bibliography of 1393 references related to research on human behavioral decision processes up to 1968 is presented. This is an up-date of a similar document compiled in 1964 by the same author. A.L.

N69-16637*# National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY A CONTINUING BIBLIOGRAPHY WITH INDEXES

Dec. 1968 187 p refs
(NASA-SP-7011(57)) Avail: CFSTI CSCL 06

The abstracts and annotated indexes were selected from those introduced into the NASA Information System during November 1968. The references were previously announced by the Library of Congress, the American Institute of Aeronautics and Astronautics, and NASA. Emphasis is placed on the biological, physiological, psychological, and environmental effects to which man is subjected during the following simulated or actual flight in the earth's atmosphere or in interplanetary space. A.L.

N69-16568*# John B. Pierce Foundation of Connecticut, New Haven.

EXPANSION OF A MATHEMATICAL MODEL OF THERMOREGULATION TO INCLUDE HIGH METABOLIC RATES Final Report, Jun. 19, 1967-Jun. 18, 1968

J. A. J. Stolwijk and D. J. Cunningham Jun. 1968 133 p refs

(Contract NAS9-7140)

(NASA-CR-92443; FR-A) Avail: CFSTI CSCL 06P

A program combining experimental and mathematical modelling was undertaken in order to extend the basic mathematical model for human thermoregulation. Exercise experiments at different levels of stress and at different ambient temperatures were used to establish steady state responses and to provide relevant physiological data for both behavioral and automatic reactions to thermal stress. G.G.

N69-16591# Oak Ridge National Lab., Tenn.

MEASUREMENT OF ABSORBED RADIATION ON SPACE FLIGHTS

B. M. Makhmudov [1968] 8 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III: Fiz.-Astron. (Moscow), v. 23, no. 2, Mar.-Apr. 1968 p 11-16

(ORNL-TR-2031) Avail: CFSTI

The results of various experiments to measure the absorbed dose of cosmic radiation during the flight of earth satellites and manned spaceships are presented and briefly discussed. NSA

N69-16592# Japan Broadcasting Corp., Tokyo.

SIMULATION OF THE NEURAL RESPONSE IN THE PERIPHERAL AUDITORY SYSTEM

Hisao Sakai and Kengo Oggshi Feb. 1968 8 p refs *Its* Note 117

(PB-179451) Avail: CFSTI CSCL 06D

Response area, inhibitory area, and the phenomenon of masking in the peripheral auditory system was simulated by computer model of the basilar membrane and the nervous connection. Author (USGRDR)

N69-16622# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETECTION OF POLYCYCLIC AROMATIC HYDROCARBONS IN ATMOSPHERIC AIR POLLUTION AND OTHER OBJECTS WITH THE AID OF QUASILINE FLUORESCENCE SPECTRA FLUORESCENCE SPECTRA

P. P. Dikun *In its* J. of Appl. Spectry. 17 Jan. 1968 p 83-91 refs (See N69-16610 06-34)

Avail: CFSTI

An investigation of urban air pollution was made with the aid of column and thin layer chromatography and spectral analysis using quasiline fluorescence spectra. Nine substances, including three compounds possessing very high carcinogenic activity, were detected in atmospheric contaminations. A comparison of possibilities of polycyclic aromatic hydrocarbon analysis is made with the help of the absorption and quasiline spectra. Author

N69-16657*# Children's Hospital Medical Center of Northern Calif., Oakland. Bruce Lyon Memorial Research Lab.

DIETARY FACTORS AFFECTING EXOGENOUS AND ENDOGENOUS SOURCES OF FAT AND CARBOHYDRATE FOR ENERGY PRODUCTION AND SYNTHESIS Semiannual Progress Report, Jul. 1-Dec. 30, 1968

S. Abraham and John C. Bartley Dec. 1968 16 p ref

(Grant NGR-05-059-001)

(NASA-CR-99220) Avail: CFSTI CSCL 06A

Dietary experiments confirm previous findings that enzymatic differences occur in rats fed two different diets for a long period. When compared to the activity of rats fed the high carbohydrate diet, the activities of hepatic glucose-6-P dehydrogenase, 6-P-gluconate dehydrogenase, citrate lyase, and total hexokinase were lower in rats fed a diet containing 45% fat. When the activities of these enzymes were measured in adipose tissue, similar differences were observed except that malic enzyme was much lower in the fat-fed animals while the total hexokinase activity was the same for both dietary groups. Tabulated data are included on the composition of isocaloric diets; the metabolic activity of liver and adipose tissue before and after a 7-day fast of rats fed a diet containing heptadecanoic acid as the sole source of fat; fatty acid composition of liver, adipose tissue, and carcass before and after a 7-day fast of rats fed a diet containing C_{17} fatty acids; and concentration of plasma glucose and free fatty acids and of hepatic glycogen before and after a 7-day fast of rats fed a diet containing heptadecanoic acid as the sole source of fat. M.G.J.

N69-16684# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPACE BIOLOGY

O. G. Gazenko 12 Jan. 1968 21 p Transl. into ENGLISH from the book "Razvitie Biologii v SSSR" Moscow, Izd. AN SSSR, 1967 p 613-631

(AD-679418; FTD-HT-23-1626-67) Avail: CFSTI CSCL 6/3

Space biology is defined as an independent area of biology dealing with three basic problems: The characteristics of the vital activity and behavior of terrestrial organisms in outer space or on rockets; The presence distribution, characteristics and evolution of living matter, possibly from another planet, in the universe; and the biological principles and methods for constructing an artificial environment in spaceships. This survey outlines the progress of Soviet space biology and notes important directions for its further development. Author (TAB)

N69-16690*# Minnesota Univ., Minneapolis. Coll. of Medical Sciences.

DEVELOPMENT AND EVALUATION OF AN IMPEDANCE CARDIOGRAPHIC SYSTEM TO MEASURE CARDIAC OUTPUT AND OTHER CARDIAC PARAMETERS, JULY 1, 1967-JUNE 30, 1968

W. G. Kubicek, D. A. Witsoe, and R. P. Patterson Jun. 1968 147 p refs

(Contract NAS9-4500)

(NASA-CR-92462) Avail: CFSTI CSCL 06B

A four-electrode impedance cardiograph was developed to provide a simple, bloodless method of monitoring various parameters of cardiac function without penetrating the skin. To evaluate the device, a comparison study was conducted of simultaneous cardiac output determinations by the impedance method and indicator dilution or Fick techniques. Composite graphs of all data submitted from nine laboratories show the absolute values of caridac output, (CO), and a plot of corrected impedance-derived CO values plotted against the original values by a standard method. Studies were also conducted to determine the validity of the transthoracic impedance method for measuring CO, and to determine its usefulness in examining the response of the cardiovascular system to a standardized postural stress. The CO was determined by the impedance and dye dilution techniques. A high correlation of absolute values for stroke volume (SV) and CO was obtained. Design criteria are given for an inflight prototype and clinical laboratory impedance electrode-cable harness system. Also included is the digital computer program for computing SV and CO from thoracic impedance changes during the cardiac cycle. M.G.J.

N69-16893*# Techtran Corp., Glen Burnie, Md.
REACTIVITY OF THE ORGANISM DURING LONG DURATION SPACE FLIGHTS [REAKTIVNOSTI ORGANIZMA V USLOVIYAKH DLITELINYKH KOSMICHESKIKH POLETOV]
P. V. Vasilyev Washington NASA Jan. 1969 7 p refs Transl. into ENGLISH from Russian Presented at 3d Intern. Symp. on the Basic Environ. Probl. of Man in Space, Geneva, 15–19 Nov. 1968
(Contract NASw-1695)
(NASA-TT-F-12087) Avail: CFSTI CSCL 06S

It has been established that weightlessness and hypodynamia produce certain changes in the function of circulation, respiration, excretion, the analyzer and regulatory systems as well as in various metabolic processes. The reorganization of these systems leads to changes in total reactivity closely related to body resistance. This paper presents an analysis of the literature data and authors' findings, indicating that weightlessness and hypodynamia result in reduced orthostatic and vestibular tolerance, increased susceptibility to infection, decreased resistance to acceleration and physical exertion, and altered reactivity to drugs. Author

N69-16916*# California Univ., Davis. Human Performance Lab.
THE EFFECT OF NINE DAYS OF RECUMBENCY, WITH AND WITHOUT EXERCISE, ON THE REDISTRIBUTION OF BODY FLUIDS AND ELECTROLYTES, RENAL FUNCTION AND METABOLISM
E. N. Bernauer and W. C. Adams Nov. 1968 177 p refs
(Grant NGR-05-004-021)
(NASA-CR-73664) Avail: CFSTI CSCL 06S

A 27 day experiment was designed to study the effects of 9 days of recumbency on the physiological systems related to the redistribution of body fluids, renal function, electrolyte exchange, and metabolism. An effort was made to explore the mechanisms of the pathophysiological changes of these systems which are seen in recumbency, relate them to weightlessness, and to predict the efficacy of procedures employed for future application to space flight. The role of the standardized efficacy bouts of exercise was studied for its effects in attenuating the alterations of the affected physiological systems during bed rest. Ten days of equilibration on a low residue diet of controlled water, electrolyte, and caloric content preceded the 9 days of recumbency. During the bed rest period, four young adult males rode on a bicycle ergometer in the supine position twice daily for 30 minutes, while four other male subjects remained inactive. Position and activity were maintained during the bed rest period. A 7 day ambulatory recovery period, in which pre-bed rest activity patterns were resumed, with ad libitum dietary intake (recorded for each subject), followed bed rest. Measurements taken during the 10 day equilibration period served as baseline comparisons for those taken during bed rest and recovery. Author

N69-16985# Stanford Univ., Calif. Dept. of Computer Science.
SOME PHILOSOPHICAL PROBLEMS FROM THE STANDPOINT OF ARTIFICIAL INTELLIGENCE
John McCarthy and Patrick Hayes Nov. 1968 51 p refs
(Contract ARPA SD-183)
(AD-678878; AI-M-73) Avail: CFSTI CSCL 6/4

A computer program capable of acting intelligently in the world must have a general representation of the world in terms of which its inputs are interpreted. Designing such a program requires commitments about what knowledge is and how it is obtained. Thus some of the major traditional problems of philosophy arise in artificial intelligence. The first part of the paper begins with a philosophical point of view that seems to arise naturally once we take seriously the idea of actually making an intelligent machine. A proposed resolution of the problem of freewill in a deterministic universe and of counterfactual conditional sentences is presented. The second part is mainly concerned with formalisms within which it can be proved that a strategy will achieve a goal. A method is given of constructing a sentence of first order logic which will be true in all models of certain axioms if and only if a certain strategy will achieve a certain goal. Author (TAB)

N69-17003# Pittsburgh Univ., Pa.
EFFECTS OF CERTAIN COMPOUNDS ON ANIMALS SUBJECTED TO SIMULATED HIGH ALTITUDE Annual Summary Report, 1 Oct. 1967–30 Oct. 1968
Joseph P. Buckley and Herbert Barry, III Oct. 1968 22 p refs
(Contract DADA17-67-C-7089)
(AD-678639; ASR-2) Avail: CFSTI CSCL 6/15

It has been previously reported that N-beta-phenethyl-biguanide (phenformin) protected both anesthetized and unanesthetized rats from the lethal effects of severe hypoxia. Data in these studies indicated that phenformin HCl protected the rats by preventing cardiovascular collapse and central depression and simultaneously producing marked respiratory stimulation accompanied by arterial PCO2 and pH significantly lower and arterial PO2 significantly higher than that found in untreated animals. In the present studies, hexamethonium abolished the pressor response of phenformin HCl in cats providing additional evidence that one of the actions of phenformin HCl is facilitation of ganglionic activity. Phenformin HCl, 75 mg/kg, orally, markedly improved the lever press shock-avoidance performance of rats tested at altitudes between 18,000 and 24,000 feet. Altitudes in excess of 21,000 feet produced a much greater detrimental effect on learning than on performance and phenformin HCl did not improve the ability of the experimental animals to learn a relatively simple avoidance program at elevated altitudes ranging from 18,000 to 24,000 feet. The compound did increase the spontaneous activities of animals subjected to a simulated altitude of 21,000 feet whereas it produced a slight sedative effect on animals at normal atmospheric pressures. Phenformin HCl, 75 mg/kg, orally, did alleviate certain detrimental effects of hypoxia of high altitude in rats but did not appear to enhance the ability of these animals to learn at elevated altitudes. Author (TAB)

N69-17025*# Techtran Corp., Glen Burnie, Md.
HISTOCHEMICAL STUDY OF OXIDATIVE ENZYMES IN THE LUNGS OF ALBINO RATS [GISTOKHIMICHESKOYE IZUCHENIYE NABORA OKISLITEL'NYKH FERMENTOV V LEGKIKH BELYKH KRYS]
I. M. Shnaydman Washington NASA Feb. 1969 5 p refs Transl. into ENGLISH from Arkh. Anat., Gistol. i Embriol. (Moscow), v. 49, no. 12, 1965 p 71–73
(Contract NASw-1695)
(NASA-TT-F-12103) Avail: CFSTI CSCL 06A

The activities of various oxidative-reductive enzymes in normal white rats were found to vary in different structures of a pulmonary tissue. Enzyme activity was high in the epithelium of the mucous membrane and of the bronchial glands, histiocytes, and fibroblasts of the inter-alveolar septa; marked, in the cartilage cells, lymphoid tissue; moderate, in the muscles of the bronchial and vascular walls; low, in the endothelium of the vessels. Enzyme activity, in decreasing order, was as follows: DPN-H-diaphorase, nitro-TB-reductase of isocitric acid, glutamic acid, cytochrome oxidase, nitro-TB-reductase of succinic acid, glucose-6-phosphate and TPN-H-diaphorase. No essential age or sex differences were observed. Author

N69-17074*# Sandia Corp., Albuquerque, N. Mex. Planetary Quarantine Dept.
CONTAMINATION CONTROL HANDBOOK (PRELIMINARY COPY)
Aug. 1968 383 p refs Prepared for AEC Revised
(NASA Order H-13245A)
(NASA-CR-98238; SC-M-68-370) Avail: CFSTI CSCL 06M

This handbook is intended for use in the aerospace and allied industries. The book covers contamination control in product design, on surfaces, in gases and liquids, and in the atmosphere. Microbial contamination and its control are treated as well as effects of radiation, packaging procedures, handling and storage methods, personnel contaminants, and training of personnel. A glossary and bibliographies are included. K.W.

N69-17085# Joint Publications Research Service, Washington, D. C.

PROBLEMS OF THE STUDY OF STRUCTURAL LEVELS OF BIOLOGICAL SYSTEMS

A. T. Shtalov *In its* Phil. Probl. of Forecasting and Organizing USSR Sci. 10 Jan. 1969 p 92-98 refs (See N69-17079 06-34) Avail: CFSTI

An overview is presented on the various papers given at a conference on the methodological aspects of natural science problems. Emphasis was placed on the need for studying the theory of structural levels of development of biological systems, especially the specifics of biological structures, and forms of conversion from one level of their organization to another. Structural, functional, and cybernetic approaches to the problems were proposed. M.G.J.

N69-17100*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

FORMATION OF AMINO ACIDS AND PEPTIDES BY RADIATION [BILDUNG VON AMINOSAEUREN UND PEPTIDEN DURCH STRAHLUNG]

K. Dose et al Washington NASA Jan. 1969 9 p refs Transl. into ENGLISH from the German Rept. BMWF-FB-W-68-30) (Contract NASw-1692) (NASA-TT-F-12089; BMWF-FB-W-68-30) Avail: CFSTI CSCL 06A

As part of an evaluation of the concept of chemical evolution of life, the composition of the primitive atmosphere of the earth and possible sources of energy are discussed. Examples and experimental data are presented of radiochemical reactions resulting in the formation of amino acids and fatty acids and in the polymerization or condensation of amino acids to peptides and proteins. Author

N69-17110# Library of Congress, Washington, D. C. Aerospace Technology Division.

BIONICS AND BIOCYBERNETICS Surveys of Foreign Scientific and Technical Literature

5 Dec. 1968 370 p refs (ATD-68-77-108-4; ATD-WA-108) Avail: CFSTI

Abstracts are presented to give a retrospective coverage and to provide specialists in the biomedical community with some indication of the scope of the Soviet effort in bionics and biocybernetics. The data covers biological modeling of human sensory processes, infra-human sensory processes, sensory system, and physiologic functions; neurons in bionics and biocybernetics; problems of modeling higher nervous activity, and of transmission, processing, and encoding of information in living organisms; animal orientation, navigation, location, and communication; biopotentials and bioelectric control system studies; biological regulatory system; artificial intelligence (pattern recognition, learning programs, and special devices); and miscellaneous items related to bionic and biocybernetic studies. An author index is included. M.G.J.

N69-17141*# National Bureau of Standards, Washington, D. C.

A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Progress Report, 1 Jul.-31 Dec. 1968

George T. Armstrong and Eugene S. Domalski 20 Dec. 1968 41 p refs (NASA Order R-138; NBS Proj. 316-11-0429; NBS Proj. 221-11-0429) (NASA-CR-99222; NBS-9968; PR-15) Avail: CFSTI CSCL 06A

As part of a continuing effort comprised of gathering and evaluating data on, and selecting best values for organic compounds of biological interest, some selected heats of combustion and formation are presented for the following classes of compounds: amino acids, peptides, certain organic compounds of biological interest, other amino acids and related compounds, amino acid anhydrides, glyceryl esters, lactones, heterocyclic nitrogen compounds, and heterocyclic oxygen compounds. The selected values are tabulated for each class of compounds. The combustion data used in making a given selection are indicated. Author

N69-17158# Florida Univ., Gainesville. Coll. of Medicine.

VISUAL CELLULAR STIMULATION BY HIGH ENERGY QUANTA Technical Progress Report, 1 Dec. 1967-1 Sep. 1968

William W. Dawson 19 Aug. 1968 26 p refs (Contract AT(40-1)-3599) (ORO-3599-4) Avail: CFSTI

The responsiveness of visual system to ionizing radiations was studied. The popular hypothesis that X-rays stimulate the visual system by interacting directly with the photo chemical or indirectly through entoptic production of fluoresence was tested. The results were clear-cut and were described in a previous report. Analyses of the statistics were highly significant indicating that the hypotheses stated above should be rejected. That is, two alternative hypotheses may be generated: X-ray excitation of rhodopsin-bearing visual structures was by direct interaction with the nervous system or indirect interaction with neural structures through the production of free radicals. Ionizing rays or free radicals produced by them had slight effects upon photopigment concentration but these effects were secondary to physiological excitation produced at places other than the photopigment in receptive structures. Further, measurement of visual function indicated no pathology of a receptive nature where X-ray doses in the 12,000 R range were delivered. This suggested that mammalian eye X-ray pathology is dependent upon cellular metabolism rather than upon photochemical and neurological membrane or chemical structures. This assumes that current theory is correct for similarities in neutral membrane structure and photopigments between vertebrate and invertebrate species. Author (NSA)

N69-17169# Oak Ridge National Lab., Tenn. Office of Language Services.

ON SOME PROBLEMS OF RADIATION PROTECTION IN COSMIC FLIGHTS, PART 2 [UEBER EINIGE PROBLEME DES STRAHLENSCHUTZES BEI KOSMISCHEN FLUEGEN, 2]

H. Swart [1968] 12 p refs Transl. into ENGLISH from Mitt. der Deut. Astron. Raumfahrt (Ger.), v. 5, no. 1, 1967 p 23-32 (ORNL-TR-1814) Avail: CFSTI

Radiation protection in a charged particle environment on space missions is considered. Data are given on solar cosmic radiation, and event probability and intensity decay factors are analyzed. The total radiation dose due to solar radiation is considered, with special attention given to questions of proton dosages acceptable to manned space crews protected by various shielding systems. Dosage tables are included. Cosmic solar radiation, with the danger of attendant proton showers, is the principal danger in deep space. The extent and intensity of earth's radiation belts are reviewed, their relation to solar activity periodicity is analyzed, and their contribution to the general radiological conditions is investigated. The screening effect of specific materials is mentioned. A brief discussion is given on artificially generated radiation belts. NSA

N69-17186# Vermont Univ., Burlington.
HYPERBARIC EFFECTS OF HIGH PRESSURE EXPOSURES ON ENDOCRINE PHYSIOLOGY Technical Report, 15 Apr. 1967-30 Sep. 1968
George R. Howe 30 Sep. 1968 4 p
(Contract N00014-67-A-0456)
(AD-678655) Avail: CFSTI CSCL 6/16

Results of continuing research using sexually mature male and female rats of the Sprague Dawley strain are reported. A hyperbaric chamber was used, with a capacity of up to 10 atmospheres above atmospheric pressure under controlled conditions of temperature and humidity. Results of tests indicate that the effects of 6 atmospheres are nontoxic to both male and female rats, and that survival with a pressure of 7 atmospheres is more likely with male rats. Analysis of the results and a study of the conditions under which the testing was conducted indicated that toxicity was most probably due to increased PO2, rather than increased PHe, or to increased pressure alone. It appeared that oxygen toxicity may exert some degree of prominence at a PO2 near 220 mmHg, particularly after the survival of four males at 7 atmospheres for 96 hours using a gaseous mixture with a lower oxygen content.
A.C.R.

N69-17196# Joint Publications Research Service, Washington, D. C.
SPACE BIOLOGY AND MEDICINE
O. G. Gazenko *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 365-422 refs (See N69-17187 06-34)
Avail: CFSTI

Unique features and interrelationships of the following basic aspects of space medicine are discussed: exophysiology, exobiology, ecology of closed systems (bioengineering), and medical problems of manned space flight. Results of biological research conducted on rockets and spaceships are tabulated, the results of which have great impact on the development of manned space flight systems. In particular, studies were made on the effects of weightlessness on cardiovascular, respiratory, and reproductive systems of dogs, guinea pigs, and rats, and the means of telemetering this information from the spacecraft to the earth. Medical research during manned flights is also summarized; experiments were conducted on radiation conditions, pressurized cabin environments, food and water supplies, and work and rest schedules. Detailed tests were also conducted on the response of the central nervous system and corresponding psychological factors.
A.C.R.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N69-16111*# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
MEASUREMENT AND DISPLAY OF CONTROL INFORMATION: REMOTE MANIPULATION AND MANUAL CONTROL Progress Report, 1 Oct. 1967-30 Sep. 1968
Thomas B. Sheridan and William R. Ferrell 30 Sep. 1968 24 p refs
(Grant NGR-22-009-002)
(NASA-CR-99230; DSR-70283-7; DSR-70283-8) Avail: CFSTI CSCL 06B

A unifying theme for half of the effort was remote manipulation, or how man can extend his hands arbitrarily in space to accomplish useful work such as exploration, maintenance, and assembly in spite of transmission delay, limited bandwidth, and noise in the telemetry loop. Beginning with an experimental study of the effects of transmission delay, it is concluded that any good solution will involve utilizing man as an intermittent supervisory controller of a remote computer, which in turn controls the mechanical hand on a fast time scale with respect to inputs from its own sensors and a slower time scale based on commands from the human supervisor. The other half of the effort has dealt with a variety of control problems of both discrete and continuous sorts. An investigation of the human operator as a time-optimal bang-bang state regulator of second order systems is being completed. Work has been completed on a theoretical study interrelating two and three time scale preview control with optimal (Weiner-Hopf) control.
Author

N69-16189 Michigan Univ., Ann Arbor.
THE BEHAVIOR OF ADAPTIVE SYSTEMS WHICH EMPLOY GENETIC AND CORRELATION ALGORITHMS
John Daniel Bagley (Ph.D. Thesis) 1967 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No 68-7556

A framework or paradigm which encompasses much of the work that has been accomplished in the field of adaptive systems is developed. This paradigm effectively separates the learning algorithm from the heuristic aspects which lie in a meta-environment. A concept of meta-environmental depth which is intended to reflect the degree of interaction among the parameters of the meta-environment is defined. An example of meta-environment which includes the game of Hexapawn and show how its depth can be made to depend upon the strategy chosen by a fixed opponent is presented. The effects of a limited range of variation of the control coefficients upon the optimizing behavior of the genetic adaptor are determined. In general, the results obtained have implications for two general areas, the theory and practice of problem solving and the theory of natural genetic systems.
Dissert. Abstr.

N69-16212*# Michigan Univ., Ann Arbor.
A STUDY OF HUMAN OPERATOR PERFORMANCE USING REGRESSION ANALYSIS
August Llewellyn Burgett Washington NASA Jan. 1969 192 p refs
(Contract NASr-54(06))
(NASA-CR-1259) Avail: CFSTI CSCL 05I

The regression analysis technique is used to analyze the performance of human operators in low order compensatory manual control systems. This study is based on two experiments in which the subjects controlled single and double integrator dynamical systems with an input which was low frequency noise. In modeling the human operator system the crossover model is used. This model expresses the entire forward-loop of the compensatory control system as a series of operators: a gain K, a time-delay τ, and a single integration. The study takes the form of obtaining estimates of the parameters K and τ for twenty-five 20-second intervals for each day of testing. From an analysis of these parameter values, inferences are made about the performance of the human operators.
Author

N69-16219# Dunlap and Associates, Inc., Santa Monica, Calif. Western Div.
ADAPTIVE TECHNIQUES FOR SYNTHETIC FLIGHT TRAINING SYSTEMS Technical Report, Jan.-Aug. 1968
Charles R. Kelley and Michael J. Wargo Orlando, Fla. Naval Training Device Center Oct. 1968 50 p refs
(Contract N61339-68-C-0136)
(AD-678536; NAVTRADEVCEN-68-C-0136-1) Avail: CFSTI CSCL 14/2

The report is concerned with the application of adaptive training techniques to Synthetic Flight Training Systems (SFTS) in general, and to the 2B24 SFTS in particular. The report is divided into four major sections. The first section discusses the basic elements for any adaptive training system, which are: valid and reliable performance measures; one or more system, task, or environment variables that directly affect task difficulty; and, an adaptive logic which automatically adjusts task difficulty on the basis of the relation of measured performance to a preset criterion of performance. The second section of the report is addressed to the major problem areas associated with application of adaptive principles to the SFTS: selection of valid and reliable performance measures and the combining of performance measurements in several degrees of freedom to provide for a single continuum of adaptation. Specific suggestions for the application of adaptive techniques to the 2B24 SFTS are detailed in the third section of the report. The fourth and final section is concerned with an experimental program for the determination of the 2B24 SFTS adaptive training parameters. Author (TAB)

N69-16257# Harvard Univ., Cambridge, Mass. Computing Center.
SOME FACTORS IN THE DESIGN OF SYSTEMS FOR COMPUTER ASSISTED INSTRUCTION
Lawrence M. Stolurow 1 May 1968 49 p refs Presented at the NATO Conf. on Major Trends in Programmed Learning Research, Nice, 13–17 May 1968
(Contract N00014-67-A-0298-0003)
(AD-678740; TR-7) Avail: CFSTI CSCL 5/9

The digital computer is a significant tool for explicating and guiding the instructional process. Today it is most useful to develop formalized and testable conceptions of instruction, but in practice it is being used more to implement instruction. The potential contribution of a CAI system as a catalyst in the process of formalizing instruction and in testing the validity of conceptions of instruction has been underestimated. An argument is made for the development and testing of teaching models that are prescriptive as well as descriptive. The most useful form of description to be used for the rules of instruction is the contingency statement. Sets of rules are combined to define teaching strategies. An urgent research problem is the identification of useful variables to include in both the if and then statements of teaching rules. Based upon previous research, the idiographic model uses variables relating to student characteristics as one component of useful if statements. Another component comes from the learning task. Five modes of instruction are described for the then statement. Author (TAB)

N69-16266# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE POWERFUL LILLIPUTIAN
L. Shuvatov 8 Dec. 1967 9 p Transl. into ENGLISH from Pravda (Moscow), no. 285, 12 Oct. 1966 p 3
(AD-678622; FTD-HT-23-1161-67) Avail: CFSTI CSCL 6/3

A microminiaturized biotelemetric complex for studying animals in their natural environment has been developed. Among the devices included in the complex are sonic and ultrasonic receivers to register various signals of cardiovascular, respiratory, and neuromuscular activity. TAB

N69-16275 Michigan Univ., Ann Arbor.
PROPRIOCEPTIVE CUES AND THEIR INFLUENCE ON OPERATOR PERFORMANCE IN MANUAL CONTROL
James Herman Herzog (Ph.D. Thesis) 1967 177 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-7626

Control engineers and psychologists have jointly participated in research intended to investigate the unique characteristics of control systems which contain a human operator. A class of tracking problems known as compensatory tracking is of special interest due to its similarity to manual control problems such as flying an aircraft. The neuromuscular control system of the human upper limb was investigated as an auxiliary source of sensory information. Analysis of a functional block diagram of the human operator indicated that a control system with interesting characteristics could be devised if the control stick were constructed to be a mechanical analog of the plant being controlled. This is called the matched manipulator control technique. The torque applied by the operator to the control stick was sensed and used as the control input to the plant. For stable plants the plant output and the control stick position were placed in correspondence. This correspondence allowed the physiological force and position feedback paths of the upper limb to furnish information to the operator concerning the state of the plant. Dissert. Abstr.

N69-16285# Human Engineering Labs., Aberdeen Proving Ground, Md.
NIGHT FLIGHT VISION. 2. PSYCHOPHYSICAL COMPARISONS OF THREE COLORS OF COCKPIT LIGHTING
Robert W. Bauer Oct. 1968 15 p
(AD-678560; HEL-TM-13-68) Avail: CFSTI CSCL 1/3

Three different spectral distributions of cockpit display lighting were investigated as to their effects on dark adaptation and visual acuity during night flight. These distributions were instrument and panel lighting red, tungsten (clear) white, and Air Force (lunar) blue-white. Cockpit-lighting brightness (photopic luminance), color and color combinations with the addition of indicator lights were controlled, and effects on dark adaptation and distant visual acuity outside the cockpit were measured. Interactions among lighting colors, photopic and scotopic visual acuities, and luminance thresholds for objects of different sizes were shown. Results were discussed in relation to the literature on dark adaptation and night vision in flight. Author (TAB)

N69-16286# Human Engineering Labs., Aberdeen Proving Ground, Md.
NIGHT FLIGHT VISION. 1. RESEARCH PROBLEMS AND METHODS
Robert W. Bauer Oct. 1968 24 p refs
(AD-678561; HEL-TM-12-68) Avail: CFSTI CSCL 5/5

Review of the literature in aviation and in vision, and consideration of photometric methods available, raise a number of fundamental questions about cockpit lighting. Dark adaptation and acuity must be examined in relation to the total cockpit light flux, the ambient illumination outside the cockpit, and the spectral composition of the light flux. Furthermore, the aircraft mission requirements must be incorporated into design decisions. The program of research recommended has a character consistent with that proposed by Bartelt, Twist and Lazo (1966). Photopic and scotopic luminance, photometric and radiometric methods, color coding and contrast, and acuity at low luminances are reviewed. Analytic methods are described, and areas requiring fundamental human factors research are indicated. Author (TAB)

N69-16350# Joint Publications Research Service, Washington, D. C.
BIOCHEMICAL INDICES OF THE REACTION OF FLIERS TO COMPLEX FLIGHT CONDITIONS
I. G. Dlusskaya et al. *In its* Space Biol. and Med., Vol. 2, No. 5, 1968 14 Jan. 1969 p 131–137 refs (See N69-16332 06-04)
Avail: CFSTI

This paper presents the results of a biochemical examination of fliers with various flight backgrounds under flight conditions complicated by the failure of the automatic pilot. The flights were made in the company of an instructor who shut off the automatic pilot. The flier performing the mission was not told of the impending

shutdown and was suddenly forced, after clarifying the reason, to take the proper measures independently for eliminating the "failure". We investigated the biochemical indices which might be expected to exhibit the greatest shifts. Author

N69-16470*# Naval Aerospace Medical Inst., Pensacola, Fla. Medical Center.
STRUCTURAL ELEMENTS IN THE CONCEPT OF MOTION SICKNESS
Ashton Graybiel 16 Dec. 1968 41 p refs
(NASA Order R-93)
(NASA-CR-99279; NAMI-1055) Avail: CFSTI CSCL 06S

A slow rotation room in a laboratory environment provides an excellent instrument for the study of motion sickness because the experimenter can control not only the stressful Coriolis accelerations, but also other important procedural and environmental variables. By exploiting this control, combined with the judicious selection of experimental subjects, it was possible to confirm many previous findings and demonstrate that manifestations of disturbances in the vestibular system fall into two distinct categories. In the first category are reflex phenomena evoked by Coriolis accelerations when the head is rotated out of the plane of the room's rotation, and revealed through systems which, under natural stimulus conditions, have functional articulations with vestibular receiving areas. Included here are a characteristic sensation of tumbling or rotation, the Coriolis oculogyral illusion, nystagmus, dizziness, and neuromuscular incoordination. The symptomatology in the second category comprises an epiphenomenon super-imposed on any manifestation of the first, when the unusual vestibular activity, presumably through facilitory-inhibitory processes, irradiates to cells or cell assemblies not normally stimulated. Author

N69-16600# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING THE RELIABILITY OF OPERATION OF THE HUMAN OPERATOR IN AUTOMATED SYSTEMS
V. D. Nebylitsyn 7 Dec. 1967 13 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 6, 1961 p 9-18
(AD-678779; FTD-HT-23-1455-67) Avail: CFSTI CSCL 5/8

Discussed in this paper are a number of problems related to the general theory of reliability of performance of human operator in the systems of automatic control. The author gives definitions of reliability and failure, considers the problem of relationship between reliability and efficiency, dwells on the part played by the extreme conditions and on the qualitative evaluation of reliability. The dependence of such reliability characteristics as prolonged endurance, resistance to disturbances, and switching-over ability, etc. upon the properties of the nervous system of the individual are dealt with in detail. The author stresses the necessity of exercising control over reliability while the operator is engaged in the fulfillment of his functions. TAB

N69-16651*# Michigan Univ., Ann Arbor. Psychology Dept.
THE ELUSIVE TRADEOFF: SPEED VERSUS ACCURACY IN CHOICE REACTION TASKS WITH CONTINUOUS COST FOR TIME
Richard Gavin Swensson Dec. 1968 97 p refs
(Grant NGR-23-005-171)
(NASA-CR-73604; REPT-08773-33-T; TR-13) Avail: CFSTI CSCL 05H

Human capability to trade accuracy for increased speed of performance underlies all predictions of recently developed random walk models for choice reaction time. The five experiments reported here attempted to discover the conditions necessary for a speed-accuracy tradeoff. All used a PDP-1 computer to present one of the two equiprobable stimuli and the subject's feedback on a cathode ray tube display. The subjects' entire payoff depended on both their accuracy and response time on each trial. Cost for response time was proportional to that time. Session-to-session changes in the payoff difference between a correct response and an error varied the relative attractiveness of speed and accuracy. Reaction times for errors were faster than for correct responses, both in response to easily discriminable stimuli and for the faster, less accurate performance found with difficult stimulus discriminations. Author

N69-16660# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MATERIALS OF THE CONFERENCE ON COSMIC BIOLOGY AND MEDICINE (SELECTED ARTICLES)
15 Mar. 1968 13 p Transl. into ENGLISH from Russian Conf. held in Moscow, 10-12 Nov. 1964
(AD-679371; FTD-HT-23-1392-67) Avail: CFSTI CSCL 6/11

CONTENTS:

1. DESICCATION OF AIR IN LIFE SAVING SYSTEMS OF HERMETIC CABINS N. P. Perfil'yev et al p 1-4 (See N69-16661 06-05)

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N69-16661# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESICCATION OF AIR IN LIFE SAVING SYSTEMS OF HERMETIC CABINS
N. P. Perfil'yev et al *In its* Mater. of the Conf. on Cosmic Biol. and Med. 15 Mar. 1968 p 1-4 (See N69-16660 06-05)
Avail: CFSTI

Desiccation of air in life preservation systems of hermetic cabins on cosmic ships is discussed. Ways of removing carbon dioxide and other harmful agents are proposed. The use of hydrophobic zeolites for carbon dioxide absorption is considered for possible application in future air moisture desiccators. Author

N69-16662# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE POSSIBILITY OF UTILIZING SEMI-FUNCTIONAL PROPERTIES OF ZEOLITES IN PHYSICO-CHEMICAL AIR REGENERATION SYSTEMS
V. K. Cherkasov et al *In its* Mater. of the Conf. on Cosmic Biol. and Med. 15 Mar. 1968 p 5-8 (See N69-16660 06-05)
Avail: CFSTI

In physical-chemical air regeneration system proposed for manned spaceflight, CO_2 is removed from cabin air by adsorption on zeolite. The CO_2 then undergoes vacuum desorption from the zeolite and passes through a CO_2 collector to the catalytic reactor, where it is reduced with hydrogen from the electrolyzer to water and methane. The water returns to the electrolyzer and is broken down into oxygen (used for human respiration) and hydrogen. The disadvantages are the difficulties of creating a vacuum on board a spacecraft and the additional electrical energy required to operate the CO_2 collector. Specially treated B-zeolite can be used in such a system for both sorption and catalysis, retaining its properties through a number of cycles. Cabin air is purified by passing through a B-zeolite adsorber. Hydrogen derived from electrolysis is then passed through zeolite in a second adsorber, simultaneously desorbing CO_2 and reducing it to water and methane. The water is electrolyzed as in the first system. Temperature regulation is very important for the successful operation of this system, since a 7° to 12°C temperature variation alters the gas conversion level by 10-15%. Author

N69-16877# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MATRIX METHOD OF PATTERN RECOGNITION AND CERTAIN PROBLEMS IN THE CONSTRUCTION OF STANDARDS

V. Yu. Trakhtman *In its* Self Teaching Autom. Systems 13 Feb. 1968 p 1-9 refs (See N69-16676 06-08)

Avail: CFSTI

The matrix method of recognizing images examined in this article is based on the idea of processing the descriptions of objects by statistical methods. The basic characteristics of the method are as follows: (1) the criterion of recognition by common metric characters, i.e., the mutual differences between isolated points of space; (2) class standards are selected by the principle of isometric invariance; (3) Boolean space is used. By applying the algorithm of the measurement of common metric characters in Boolean space it is possible to realize machine recognition since here the statistic itself is used as the standard and the signs of recognition remain non-isolated in the standard. In this case the specific character of the objects determines the selection of the element of description. Nevertheless, further processing, even up to construction of the standards, is completely unified. Small experiments on recognizing hand-written letters and sounds of Russian speech were carried out by this method. These experiments confirmed the initial premises and will be continued on an expanded scale. Author

N69-16876# Indiana Univ., Bloomington. Div. of Optometry.

EXTRAHOROPTERAL DISTANCE PERCEPTION IN TRACKING PERFORMANCE Final Report

Rogers W. Reading Sep. 1968 104 p refs

(Contract DA-49-193-MD-2706)

(AD-679173) Avail: CFSTI CSCL 5/10

Extrahoropteral stereopsis is the binocular perception of depth that arises from objects located at relatively large distances from the horopter. The study is concerned with the question of whether extrahoropteral stereopsis clues of disparity magnitudes comparable to those prevailing in common vehicle operating conditions can provide feedback useful in compensating for interference in a tracking task. The results, while inconsistent, suggest only a slight apparent superiority for conditions which allow judgments to be based on extrahoropteral stereopsis. Supplementary investigations on the same subjects indicate that feedback from other clues may have been as good as or better than that provided by extrahoropteral stereopsis and that estimations of the actual distances of objects located extrahoropterally showed consistent errors sufficient in magnitude to have rendered extrahoropteral clues ineffective. Author (TAB)

N69-16885# Naval Submarine Medical Center, Groton, Conn. Research Lab.

THE USE OF CIRCUMAURAL EARPHONES IN AUDIOMETRY

J. Donald Harris Jul. 1968 28 p refs

(AD-678918; SMRL-540) Avail: CFSTI CSCL 9/1

Four circumaural muffs were compared with the phone/cushion device now standard for audiometry, the Willson Sound-Barrier, the Maico Auraldome, and 2 versions of the Tracor Otocup. Psychoacoustic loudness balancing by normal subjects was performed, and physical measurements by probe-tube microphone and by flat-plate coupler. Neither physical method was related closely enough at 4 + kHz to the fundamental loudness balancing to serve as an independent calibration system for all circumaural muffs. Author (TAB)

N69-16920# Human Engineering Labs., Aberdeen Proving Ground, Md.

CHRONIC FREE OPERANT AVOIDANCE AS A PSYCHOLOGICAL STRESS: A RE-EVALUATION

Murry D. Levine, Thomas P. Gordon, William J. Johnson, and Robert M. Rose Sep. 1968 23 p refs

(AD-679153; HEL-TM-10-68) Avail: CFSTI CSCL 5/10

Rhesus monkeys were maintained for 30 days on a modified free operant avoidance schedule in order to evaluate this paradigm as a chronic stress. Subjects were run in four groups to assess the separate contributions of human contact, intersubject interaction and chair restraint. Urinary 17-hydroxycorticosteroid levels and gastrointestinal ulcers were used as stress measures. Chronic exposure to this paradigm did not necessarily produce a stressed organism or gastrointestinal pathology. The adrenal corticosteroids did, however, provide a sensitive, objective index of emotionality. Author (TAB)

N69-16944# Army Medical Research Lab., Fort Knox, Ky.

DESCRIPTION OF OPTOKINETIC DEVICE

James W. Wolfe, Joseph R. Nall, and Cosmo D. Pupura Jun. 1, 1968 16 p

(AD-679030; USAMRL-783) Avail: CFSTI CSCL 20/6

An optokinetic drum capable of providing moving visual stimuli from 6 deg/sec to 120 deg/sec has been constructed. The main drive is provided by a Vickers hydraulic transmission. Control of drum velocity varies from an error of 15% at 2 RPM to .7% at velocities of 6 RPM and above. In addition, it is possible to accelerate the device on a linear ramp quite accurately. The device provides a wide choice of stimulus presentations and can be used for a number of experiments related to oculomotor function. Author (TAB)

N69-16948*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

LITHIUM PEROXIDE TEST PROGRAM Final Report

R. A. Baum, Jr., T. E. Fitzsimmons, and K. J. Dresser 6 Jan. 1969 129 p refs

(Contract NAS9-8159)

(NASA-CR-92490; SVHSER-5243) Avail: CFSTI CSCL 06K

The use of lithium peroxide to control carbon dioxide and supply oxygen for an advanced portable life support system was experimentally evaluated. Tests were conducted to generate system design data and to evaluate the effects of chemical bulk density, catalyst addition, bed temperature and geometry, and quantity of lithium peroxide on performance. Lithium peroxide was investigated in form of low and high bulk density granules, both catalyzed with 2% nickel sulfate (to promote oxygen release) and uncatalyzed. The catalyzed, low bulk density material performed best. The most critical operating parameter was bed temperature. Due to the high level of carbon dioxide and water vapor fed to the canister, temperatures in excess of 600°F were measured. High bed temperatures deter carbon dioxide removal but enhance oxygen evolution due to thermal decomposition. The results show that a carbon dioxide control and oxygen supply system utilizing lithium peroxide offers both a suit-mounted and vehicle weight-and-volume advantage over other systems. A weight and volume comparison of this system is made with the lithium hydroxide/oxygen system. K.W.

N69-16977# Joint Publications Research Service, Washington, D. C.

ASYMPTOTIC PROPERTIES AND APPROXIMATION OF STOCHASTIC TRAINING MODELS

Ye. S. Usachev *In its* Cybernetics and Regulation Theory 16 Dec. 1968 p 1-6 refs (See N69-16976 06-19)

Avail: CFSTI

Theorems are derived for examining the asymptotic properties of stochastic training models. Simple training procedures consisting of a number of sequential experiments are analyzed based on a behavioristic model. A.C.R.

N69-16990*# College of the Virgin Islands.
RESEARCH IN THE OPTIMIZATION OF SEPARATOR SUB-SYSTEMS FOR GC/MS LIFE DETECTION INSTRUMENTATION Annual Report, 15 Nov. 1967–15 Dec. 1968
15 Dec. 1968 24 p
(Grant NGR-52-083-002)
(NASA-CR-73751) Avail: CFSTI CSCL 06B

The investigation of designs and the procurement of a gas chromatograph/mass spectrometer are reported. Calibration was done in the 0.1, 1.0, and 10.0 ugm regions of ethyl laurate and xylene. The Lipsky separator was assembled, and inital tests were begun. N.E.N.

N69-17010# Aerospace Medical Lab., (Clinical), Lackland AFB, Texas. Wilford Hall USAF Hospital.
AN EVALUATION OF A NEW TOTAL BODY ERGOMETER, AUGUST 1967–FEBRUARY 1968
George O. Gey, John W. Ord, and William E. Thornton Aug. 1968 14 p Submitted for publication
(AD-679150; AMLC-TR-68-12) Avail: CFSTI CSCL 6/14

Prolonged space flight will depend upon the availability of some means of exercise that will maintain cardiopulmonary reserves and prevent loss of regional muscle strength. This exercise must be compatible with a weightless environment, the confinement of a space craft, and the personal equipment of its occupants. In order to satisfy these requirements, a total body ergometer was designed which consisted of a horizontal bar that could be moved vertically. The bar was connected to coiled springs and weighted inertial wheels by chain pulleys. Twelve subjects were exercised on the ergometer for three to five minute periods and allowed to rest for five to ten minutes between exercise periods. The bar was moved at a rate of four second cycles. The load was increased progressively by 10 pounds for each period. All subjects were evaluated by treadmill runs for three minutes and they were allowed ten minute rest periods between runs. The bar was moved at a rate of four second cycles. Speed and grade of the treadmill were increased in accordance with the response of the subjects. Author (TAB)

N69-17034*# Illinois Univ., Urbana. Biological Computer Lab.
AUTOMATIC DETERMINATION OF INVARIANCE
John Schill 1 Dec. 1968 64 p refs
(Grant NGR-14-005-111; Contract AF 33(615)-3890; Grant AF-AFOSR-7-67)
(NASA-CR-73733; BCL-7.4) Avail: CFSTI CSCL 05G

A method for determining significant patterns for the identification of spoken words was developed. The method is based on the work of Gazdag and uses his concept of significant subsequences (SSS) which in turn is based on machine representation of spoken words. A system was assembled using an algorithm for ascertaining these SSS implemented on the ILLIAC II. This system consists of an encoder, a sampler for the encoder, and a digital computer. The spoken digits were recognized by this system using the concept of the SSS. Author

N69-17088# Bunker-Ramo Corp., Canoga Park, Calif. Systems Effectivaness Dept.
THE IMPACT OF MANPOWER REQUIREMENTS AND PERSONNEL RESOURCES DATA ON SYSTEM DESIGN Final Report, 1 Jun. 1967–31 May 1968
David Meister, Dennis J. Sullivan, and William B. Askren (AMRL) Wright-Patterson AFB, Ohio AMRL Sep. 1968 224 p refs
(Contract F33615-67-C-1650)
(AD-679864; AMRL-TR-68-44) Avail: CFSTI CSCL 5/1

The purpose of this study was to determine the effect on system design of using manpower requirements (MR) and personnel resources data (PRD) as design requirements. Equipment and personnel inputs, e.g., quantity and skill level of manning and task information, were presented incrementally to six design engineers in a simulation of the Phase 1A/1B development of the Titan 3 propellant transfer and pressurization subsystem. Subjects were required to create a complete subsystem design, including schematics, equipment descriptions, drawings and bills of material. Cost effectiveness measures were applied to the data. The results of the study indicate that if personnel factors are to be incorporated into design, it is necessary to supply PRD inputs as design requirements to the engineer in his initial statement of work. The analyses upon which MR and PRD inputs are based must be performed prior to the issuance of a Request for Proposal and not delegated to a development contractor. Author (TAB)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N69-16112*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
DEDUCTION OF STATIC TEMPERATURE IN NITROGEN BY MEANS OF SPARK SPECTROSCOPY: A FEASIBILITY STUDY
James Kallis Nov. 1968 179 p refs
(Grant NGR-05-020-116)
(NASA-CR-99231; SUDAAR-364) Avail: CFSTI CSCL 07D

The analytical part of an experimental study of the feasibility ultimately of measuring the static temperature of flowing nitrogen in a hypersonic wind tunnel by means of spark spectroscopy is presented. The intention is to deduce the effective rotational temperature of the spark, and hence the static temperature, from the relative line intensities within an emission band. The spark is struck perpendicular to the flow in the tunnel test section. Author

N69-16135 California Univ., Berkeley.
APPLICATIONS OF MASS SPECTROMETRY TO ORGANIC GEOCHEMISTRY
Patricia Ann Haug (Ph.D. Thesis) 1967 306 p
Avail: Univ. Microfilms: HC $13.95/Microfilm $3.95 Order No. 68-10333

A modified mass spectrometer was adapted for routine analysis of microgram quantities of geochemical samples (incorporating a direct inlet system with a liquid nitrogen cooled probe and a Wien filter and ion multiplier with accompanying fast response recording system). High resolution mass spectra were determined on the mass spectrograph employing collection of all ions simultaneously in the plane of double focus on a photographic plate, data acquisition on incremental magnetic tape using a high precision microphotometer, and computer calculation of relative ion abundances and empirical compositions. The identification of series of normal, *iso-*, *anteiso*, *n*-alkylcyclohexyl, and isoprenoid alkanes from the Abbott Oil (3×10^8 years), San Joaquin Valley Oil (30×10^9 years), Moonie Oil (200×10^6 years), Antrim Shale (265×10^6 years), Nonesuch Oil (2×10^9 years), and Soudan Shale (2.7×10^9 years) is presented. Dissert. Abstr.

N69-16139 Illinois Univ., Urbana.
SOLID-STATE REACTIONS FORMING THE (Pb, Sr) (Ti, Zr)O_3 SOLID SOLUTION
Norman Howard Harris (Ph.D. Thesis) 1967 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-8097

The reactions were studied using differential thermal analysis, thermogravimetric analysis, X-ray diffraction and chemical analysis. The role of strontium substitutions for lead was observed to form intermediate solid solutions such as $(Pb,Sr)TiO_3$ and $(Pb,Sr)ZrO_3$. Weight loss studies for the formation of the solid solution $Pb_{1-z}Sr_zTi_{1.46}Zr_{0.54}O_3$, where $z = 0$, 0.03, 0.06 and 0.09, indicated that at 850°C the time required for complete reaction of the $SrCO_3$ increased with increasing strontium concentrations. The formation of the $(Pb,Sr)\ Ti,Zr)O_3$ solid solution was demonstrated by differential thermal analysis to produce some liquid PbO phase and thus did not proceed through a true solid state reaction. Thermodynamic calculations indicated the mechanism of reaction of $SrCO_3 + TiO_2$ (1:1 mole ratio) was by formation of a compound. The $PbO + TiO_2$ reaction was studied with a PbO vapor-TiO_2 single crystal system, and formation of a product layer containing only $PbTiO^3$ was observed on both sides of a platinum wire marker. The result indicates that $PbTiO_3$ was formed by a counter diffusion of Pb^{2+} and Ti^{4+} ions instead of by PbO migration into TiO_2 as reported in the literature. Dissert. Abstr.

N69-16147 Michigan Univ., Ann Arbor.
THE HYPERFINE STRUCTURE CONSTANTS OF SODIUM IODINE
Carl Elmer Miller (Ph.D. Thesis) 1967 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-7672

A molecular-beam electric-resonance spectrometer was constructed and used to study the radiofrequency spectrum of $^{23}Na\ ^{127}I$ for transitions between the hfs levels of the first rotational state. Transitions for the first four vibrational states were observed in near-zero electric and magnetic fields, and the spectral lines were found to exhibit a natural line width of 2.5 kHz. All the constants necessary to describe the molecule with the $^1\Sigma$ hfs Hamiltonian were determined from the observed rf spectrum. This had not been done previously for a heteronuclear, diatomic molecule in which both nuclei have quadrupole moments. Within the accuracy of these measurements, the magnetic coupling constants were found to be independent of the particular vibrational state with a maximum change for each vibrational state of ±0.06 kHz. Dissert. Abstr.

N69-16167 Ohio State Univ., Columbus.
SOME INTERFACIAL PROPERTIES OF FACE CENTERED CUBIC COBALT
Lawrence Frederick Bryant (Ph.D. Thesis) 1967 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-8805

The surface, grain boundary, and twin boundary energies, as well as the surface diffusion coefficient, of cobalt were determined from tests at 1354°C in pure hydrogen. A value of 1970 ergs/cm^2, with a standard deviation of ±175 ergs/cm^2, was calculated for the surface energy. This value was obtained from the creep rates of five mil diameter wires, using the zero creep method. It was possible to measure the creep strains at room temperature because the phase transformation was accompanied by negligible irreversible strain and no kinking. Thermal cycling through the transformation range produced surface striations similar to those which have been observed on cobalt whiskers and single crystals. Periodic grain counts showed that very long time was required for the wires to attain a stable grain size. Dissert. Abstr.

N69-16168 Michigan Univ., Ann Arbor.
THE KINETICS OF SOLUTION OF SEVERAL GASES IN LIQUID IRON AND IRON ALLOYS
William Michael Boorstein (Ph.D. Thesis) 1967 320 p
Avail: Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 68-7563

The kinetics of solution were studied of each of the elemental diatomic gases, nitrogen, hydrogen, and oxygen, in liquid iron. A constant volume technique was used involving rapid introduction of the purified gas at a predetermined initial pressure into a water-cooled Vycor reaction chamber which contained the inductively heated melt. The pressure change in the reaction chamber resulting from absorption (or desorption) of the gas by the melt was monitored as a function of time with the aid of a pressure transducer-recorder arrangement. Kinetic measurements were made over a range of values of externally controllable variables: gas pressure, temperature, stirring rate, metal charge weight and composition, and gas-liquid interfacial area. The data on the effect of these variables were examined on the basis of mathematical models which treated possible mechanisms involved in transporting material between the bulk gas phase and the bulk liquid phase. Dissert. Abstr.

N69-16182 Institute of Paper Chemistry, Appleton, Wis.
AN INVESTIGATION OF STREAMING CURRENT METHOD FOR DETERMINING THE ZETA POTENTIAL OF FIBERS
John Alfred Ciriacks (Ph.D. Thesis) 1967 138 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-9698

A relationship between the zeta potential and the streaming current from mats of cylindrical fibers was derived using a flow model. Applying experimental data to this relationship resulted in constant values for the zeta potential at various mat porosities (void fractions) in the range 0.60 to 0.85 and at electrolyte concentrations of $1-4 \times 10^{-4}$ molar KCl and $0.5-2 \times 10^{-4}$ M $CaCl_2$. The new streaming current relationship represents an improvement over the usual capillary-flow-model approach to the streaming current phenomenon in fiber mats. With the latter approach, a systematic increase in calculated zeta potentials as a function of increasing porosity was noted. The streaming current data appeared to be quite sensitive to fiber orientation in the mat. Fiber orientation was used to explain the difference in the extent of zeta potential variation as a function of porosity between this study and studies which used 1-inch diameter fiber mats. The sensitivity to fiber orientation emphasizes the anisotropic character of fiber mats. Dissert. Abstr.

N69-16207 Arkansas Univ., Fayetteville.
CATALYST EFFECTIVENESS FACTORS FOR LIQUID-PHASE HYDROGENATION REACTIONS
Nicholas Charles Nahas (Ph.D. Thesis) 1968 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-9641

A method is proposed for the estimation of catalyst effectiveness factors for reactions of the type A + B → product(s) which are first order with respect to reactant A and zero order with respect to B. Experimental rate data were obtained for the liquid phase hydrogenation of tertiary butylbenzene on four sizes of supported nickel catalyst (through 80 mesh to 1/4 in. diameter). Reactions were carried out at 600 psig pressure and 210° F in a stirred high pressure autoclave, using 90 to 95 volume percent cyclohexane solvent. Because the reaction was approximately 1/6 order with respect to tertiary butylbenzene (reactant B) rather than zero order, the experimental effectiveness factors ranged from 6 to 40 percent lower than predicted by the proposed method. Dissert. Abstr.

N69-16215* California Univ., Los Angeles. Dept. of Chemistry.
THE INTERSYSTEM CROSSING TO AND THE PHOSPHORESCENCE FROM THE INDIVIDUAL SUBLEVELS OF THE LOWEST TRIPLET STATE IN PYRAZINE AT 1.6K
M. A. El-Sayed Aug. 1968 26 p refs *Its* Contrib. 2285
(Contract Nonr-4756(07); ARPA Order 306)
(AD-679238) Avail: CFSTI CSCL 7/5

The observed exponential phosphorescence decay of pyrazine in cyclohexane or benzene matrix wt 77K, with lifetime of 18 millisec, is found to change into a complex decay below 10K. At 1.6K, the decay is resolved into three first-order decays of lifetimes 6, 130 and 400 millisec. These lifetimes are sensitive to changes in temperature and magnetic field strength. Two mechanisms are proposed to explain the observed results, but both propose that at 1.6K, the spin-lattice relaxation process between the sublevels of the triplet state is slow compared to the 6-millisec radiative lifetime of the tau(y) spin sublevel. The recent time-resolved polarization measurements of pyrazine phosphorescence in durene indicate that the second mechanism should be at least partially responsible for the observed results. Author (TAB)

N69-16227 California Univ., Berkeley.
ELECTRONIC SPECTRA OF RADICAL ANIONS IN SOLUTION
Paul Isaac Kimmel (Ph.D. Thesis) 1967 183 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-10350

The optical spectra of the ions of several conjugated molecules are investigated. A method of generating these ions by electrolysis in liquid ammonia is described and compared with the more commonly used chemical reduction method. The calculated energy levels and oscillator strengths of these ions are compared with the experimental spectra. It is proposed that such a theory should not be restricted to consideration of only singly excited configurations, and calculations are performed using extensive configuration interaction. A computer program which accomplishes this is described and listed. This extended theory is applied to several molecules and their ions. The spectra of napthalene and anthracene are discussed and compared with previous work. The electronic spectrum of the cyclooctatetraenyl radical anion is discussed, and new evidence presented that this species is planar and aromatic. The theory is applied to a large molecule, chrysene, and also to a group of four nitrogen heterocyclic ring compounds: pyrazine, pyridine, pyrimidine, and pyridazine. Dissert. Abstr.

N69-16228 IIT Research Inst., Chicago, Ill.
AN INFRARED INVESTIGATION OF SOME AMINO ACID COMPLEXES
John Allen Kieft (Ph.D. Thesis) 1968 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-9845

An infrared investigation from 400 to 200 cm^{-1} was performed on both bidentate and unidentate complexes of glycine and alanine with platinum (II). Bands were assigned in an empirical manner with particular attention focused on those attributable to vibrations of the coordinate bonds. The band appearing at around 550 cm^{-1} in both the unidentate and bidentate complexes was assigned to platinum–nitrogen stretching. This absorption is of low intensity in the unidentate complexes. A band which appears at around 400 cm^{-1} in only the bidentate complexes was assigned to platinum–oxygen stretching. Hence the infrared spectrum of this type of complex may be used to determine if the amino acid is bound as an anion or neutral molecule by examination of the 1800 to 1600 cm^{-1} region, or, if the amino acid is bound as a unidentate or bidentate ligand by examination of the 600 to 300 cm^{-1} region. Dissert. Abstr.

N69-16230 Massachusetts Univ., Amherst.
A SPECTROSCOPIC INVESTIGATION OF THE SPECTRAL NORMAL EMITTANCE OF ULTRA-HIGH PURITY ALUMINUM
Joseph Vincent Curcio (Ph.D. Thesis) 1968 175 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-9173

An apparatus is constructed and tested for the measurement of the spectral normal emittance of specially prepared specimens of ultrapure aluminum in the wavelength range 2.0 to 14.0 μ and between 400 and 1100 F. Emittances vary from 0.200 to 0.005 for finely polished specimen surfaces and from 0.80 to 0.40 for coarsely polished or lathe cut specimen surfaces. Photomicrographs (up to 500X) are taken before and after emittances. It is found that the surface preparations have a direct influence on the spectral normal emittance. The surface preparations include abrading with various grades of emery, lap polishing with 400 alundum (5 μ Al_2O_3) and for some specimens, lap polishing with 600 alundum (1.2 μ Al_2O_3). Dissert. Abstr.

N69-16235 California Univ., Berkeley.
THE TRANSPORT PROPERTIES OF CONCENTRATED ELECTROLYTIC SOLUTIONS
Thomas W. Chapman (Ph.D. Thesis) 1967 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-10301

The fruitful application of refined analytic techniques for treating mass transfer problems in electrochemical systems, whether these systems be experimental tools or industrial processes, requires accurate values of the transport properties of electrolytic solutions. We investigate here some problems in the definition, measurement, and correlation of these properties in concentrated solutions. The flux expression which is usually used for describing mass transport in electrolytic solutions is inadequate at high concentrations and in multicomponent systems. We discuss a set of flux expressions which are generally applicable. These equations serve to define the proper number of independent transport properties which are state properties of a system and which have a more direct fundamental significance than those measured experimentally. To investigate the dependence of these transport properties on concentration and temperature, we calculate their values for the 32 systems for which sufficient data are available. Dissert. Abstr.

N69-16238 North Carolina State Univ., Raleigh.
THE ETA CARBIDES OF MOLYBDENUM–IRON, MOLYBDENUM–COBALT, AND MOLYBDENUM–NICKEL
Anna Clyde Fraker (Ph.D. Thesis) 1967 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-4377

The alloy chemistry of eta carbides was investigated to show the composition ranges at 1000°C for η_1 (M_6C) and η_2 ($M_{12}C$) phases where M refers to molybdenum plus iron, cobalt, or nickel ranging from a 1:1 to a 2:1 atomic ratio. After heat treating *in vacuo* at 1250°C for 20 hr and at 1000°C for 150 hr, samples were water-quenched and were studied by metallographic and X-ray diffraction methods. Carbon analyses were made by the gas-volumetric technique. The metal composition range for molybdenum–iron–carbon is 2 at. percent around the ideal A_3B_3C composition and this extends to a 16 at. percent range, or A_3B_3C to A_4B_2C, for the systems with cobalt and nickel. The Mo:C ratio for η_1 (M_6C) cannot be less than 3:1 and does not exceed 4:1. The Mo:C ratio for η_2 ($M_{12}C$) is 6:1. A plot of the lattice constant versus the molybdenum content shows the effect of molybdenum to be greater in the system with iron than in those with nickel and cobalt. Dissert. Abstr.

N69-16240 Delaware Univ., Newark.
THE SIMULTANEOUS ABSORPTION OF TWO GASES IN A REACTIVE LIQUID
Lloyd Arnold Goettler (Ph.D. Thesis) 1967 260 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.25 Order No. 68-9599

The penetration theory differential equations are solved numerically for finite second-order constants and irreversible reactions of both gases. The solutions indicate important differences from the absorption of a single gas and the absorption of two

gases when each reacts infinitely fast. They cover a range of two orders of magnitude in the ratios of rate constants and interfacial concentrations of the two gases and predict up to a twenty-fold increase in the absorption rate. When only one of the gases reacts infinitely fast, and the other reacts slowly, both a reaction plane and a diffuse reaction zone exist in the liquid. The previous solution does not include this special case, which is instead treated according to the film theory model. When the reaction rate constant, liquid reagent concentration, and contact time are large, an asymptotic expansion gives a close approximation to the numerical solution for this case. Dissert. Abstr.

N69-16242 State Univ. of Iowa, Iowa City.
TRANSIENT BEHAVIOR OF A LAMINAR FLOW CHEMICAL REACTOR
Emil Harris Isaacson (Ph.D. Thesis) 1968 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-10465

The steady state and transient behavior of an isothermal laminar flow chemical reactor was studied experimentally and analytically using the liquid phase reaction of ammonium hydroxide and formaldehyde to form hexamethylenetetramine. The reaction was investigated in a batch reactor. An empirical rate expression of the form, $1.3F^{2.75}\ A^{1.25}$, where F is the concentration of formaldehyde and A is the concentration of ammonium hydroxide, was established at 23.8°C. A mathematical model using an effective axial dispersion coefficient was solved by the method of quasilinearization: a second model using a segregated laminar flow profile was solved by the method of characteristics. Although the steady state results could be represented equally well by both models, the transient results were not well represented indicating that the radial profiles had been considerably flattened. Dissert. Abstr.

N69-16249# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMISTRY OF FERROCENE
A. N. Nesmeyanov 24 Jan. 1968 28 p refs Transl. into ENGLISH from Zh. Vses. Khim. Obshch (USSR), v. 7, no. 3, 1962 p 249-263
(AD-679384; FTD-MT-24-390-67) Avail: CFSTI CSCL 7/3

A discussion is given of the chemistry of ferrocene and discusses separately each typical reaction carried out with ferrocene, presenting corresponding reaction schemes for sulfonation, acylation, Friedel-Craft alkylation and electrophylic substitutions. Furthermore, he analyzes the condensation process of ferrocene with aldehydes. Mercuration, metalization of ferrocene by alkyl-lithium, and alkyl-, or aryl-sodium are mentioned and also arylation reactions with diazo compounds. Three different methods were developed by the author to determine the structure of ferrocene. In contrast to benzene, dialkylferrocenes with different rings show that electrophylic substitutes enter differently into the second, or third position in relation to the alkyl group. TAB

N69-16279# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUCLEAR MAGNETIC RESONANCE (SELECTED ARTICLES)
12 Oct. 1967 26 p refs Transl. into ENGLISH from Yadernyy Magnitn. Rezonans (Leningrad), no. 1, 1965 p 83-89 96-99; 138-143
(AD-678763; FTD-HT-23-678-67) Avail: CFSTI CSCL 20/8

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N69-16280# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE ELECTROLYTE STRUCTURE IN AN ION EXCHANGE RESIN PHASE BY A NUCLEAR RESONANCE METHOD
P. M. Borodin et al *In its* Nucl. Magnetic Resonance (Selected Articles) 12 Oct. 1967 p 1-7 refs (See N69-16279 06-06)
Avail: CFSTI

Anion and cation exchange resins saturated with hydrofluoric (HF) and trifluoroacetic (CF_3 COOH) acids of various concentrations were studied. Measurements of chemical displacements in F^{19} signals were used as a basis for studying the properties of the ion exchange resins and also the structure of the electrolyte absorbed by the resins. Curves are given showing the chemical displacements in the resonance signal as a function of HF concentration in cation, anion, and copolymer resins. These curves are compared with that for the chemical displacement of H^{19} in HF as a function of concentration in the free state. The curve for the cation behaves identically to that for the free acid which indicates a small interaction between the electrolyte and the lattice of the resin. The coincidence between the curves for the free acid and the electrolyte absorbed by the copolymer indicates that the lattice of the copolymer has less effect on the state of the electrolyte than that of the ion exchange resins. Experiments with trifluoroacetic acid showed a single narrow resonance line for acid absorbed by the resin. Author

N69-16281# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUCLEAR MAGNETIC RELAXATION IN DIAMAGNETIC ELECTROLYTE SOLUTIONS
V. I. Chizhik et al *In its* Nucl. Magnetic Resonance (Selected Articles) 12 Oct. 1967 p 8-11 refs (See N69-16279 06-06)
Avail: CFSTI

The effect of dissolved electrolytes on the intensity of spin-lattice relaxation in water was studied. The relaxation time was measured by the pulse method using a sequence of 180-90-180° rf pulses. The measurement error was 2%. Specimens with solutions of $HClO_4$, HNO_3, HCl, as well as with solutions of calcium and cadium salts in these acids were sealed in small vials. Curves are given showing the spin-lattice relaxation time for water protons as a function of electrolyte concentration for the various acids and salts studied. Experiments on hydration of chlorine, nitrate and perchlorate anions showed the following series for mobility of water molecules: $ClO_4 > NO_3 > Cl$. Bivalent calcium and cadmium cations have a strong structuring effect on the water molecules surrounding them and should form large and extremely stable hydrate shells. It was found that the hydrogen ions in HCl solutions contribute less to the relaxation time than in $HClO_4$ and HNO_3 solutions. This indicates that hydrochloric acid undergoes incomplete dissociation even in small concentrations. Author

N69-16294 Pittsburgh Univ., Pa.
STRUCTURE OF THE INTERPHASE IN GAS-LIQUID AND LIQUID-LIQUID SYSTEMS
Sivan Chandrasekhar (Ph.D. Thesis) 1967 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-9737

This paper is concerned with an investigation of the liquid-liquid and gas-liquid interfacial zones. The n-butanol-water system was studied in the immiscible range. During the diffusion

of acetic acid from the aqueous to the butanol layer no significant interfacial resistance was found to exist. In the other immiscible liquid–liquid system investigated namely, water-solute-toluene, significant interfacial resistances of the order of 10^4 sec/cm were found to exist. The solutes used were acetic, propionic and octanoic acids and the experiments were performed both with and without surface-active agents. Studies of the gas–liquid interface were also made. The transfer of water across the air–glycol interface was investigated using a Diffusion Instrument incorporated with Rayleigh interferometric and Schlieren optical systems. Significant interfacial resistances were observed. Dissert. Abstr

N69-16295 California Univ., Berkeley.
MULTICOMPONENT DIFFUSION: GENERALIZED THEORY WITH ION-EXCHANGE APPLICATIONS
Ronald Norris Clazie (Ph.D. Thesis) 1967 266 p
Avail: Univ. Microfilms: HC $12.15/Microfilm $3.45 Order No. 68-10303

In this study an orderly scheme for distinguishing diffusion fluxes and their frames of reference is presented, together with a generalized relation for converting from one type of flux to another and from one reference frame to another. Likewise, a consistent method of defining and identifying diffusion coefficients is developed. Generalized relations are provided for converting from a system of equations using one type of diffusion coefficient to a system using another type. The utility of the weight-equivalent fraction and the weight-equivalent flux and frame of reference in ion-exchange systems is established. The relations between ternary and binary diffusion coefficients based on the kinetic-theory model are converted to more fundamental forms and are applied to multicomponent ion exchange. Various approximations of the multicomponent-ion-exchange rate equations are investigated, and transformations are developed which convert the column equations to intermediate forms of potential future interest for both analytic and numerical studies. Dissert. Abstr.

N69-16302 Kansas State Univ., Manhattan.
AN EVALUATION OF POLYOLEFINS AS GAS CHROMATOGRAPHY SUPPORTS AND STUDIES IN SORPTOMETRY
Gary Thomas Bender (Ph.D. Thesis) 1968 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-9900

The gas chromatographic properties of various polyolefins have been determined. The high and low density polyethylene samples were not useful as supports for gas chromatography. On the other hand, polypropylene appears to have application both as a support and as a monophase gel type column. The mechanisms of separation on the dry polymer have been investigated by studies of efficiency and specific retention volume data. Compounds containing organic carbon-hydrogen seem to be partitioned by solution into the dry polymer, while water and hydrazine interact with the polymer by adsorption. The polypropylene column has been used for water analysis in some organic solvents. A dynamic sorptometer has been developed that is useful between $10 m^2/g$ and $10^{-2} m^2/g$. Dissert. Abstr.

N69-16305 National Lending Library for Science and Technology, Boston Spa (England).
PROBLEM OF CURRENT YIELDS IN THE ELECTROLYTIC-OXIDATION AND ELECTROLYTIC-REDUCTION REACTIONS. 1. DEPENDENCE OF CURRENT YIELD ON THE DURATION OF THE ELECTROLYSIS. THE METHOD OF ELECTROSYNTHESIS WITH HIGH CURRENT YIELDS [PROBLEMA VYKHODOV PO TOKU V REAKTSIYAKH ELEKTROOKISLENIYA I ELEKTROVOSSTANOVLENIYA. 1. ZAVISIMOST VYKHODA PO TOKU PRODOLZHITELNOSTI ELEKTROLIZA. METOD VEDENIYA ELEKTROSINTEZA S VYSOKIMI VYKHODAMI PO TOKU]
N. E. Khomutov Nov. 1968 12 p refs Transl. into ENGLISH from Izv. Vyssh. Uch. Zav., Khim. i Khim. Tekhnol. (USSR), v. 7, no. 2, 1964 p 257–262
(NLL-RTS-4793) Avail: Natl. Lending Library, Boston Spa, Engl.: 15s

The dependence of current yield on the duration of electrolysis and on experimental conditions is studied. The problem of current yields and the development of methods of electrolysis which will produce high yields are important factors in introducing electrochemical methods into the organic syathesis industry. For this purpose, formulae are derived for calculating yields in electrolytic oxidation reactions when the electrolysis is conducted at a constant current intensity. A method is suggested for the electrosynthesis, and a design of the corresponding electrochemical cell is presented, which, for reactions complying with specified conditions, insures current yields near 100%. A.C.R.

N69-16318# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USAGE OF A FLAME-IONIZATION DETECTOR FOR QUANTITATIVE DETERMINATION OF IMPURITIES IN ORGANIC COMPOUNDS
P. Luyga et al 1 Dec. 1967 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk Est. SSR: Ser. Tekhn. i Fiz. Mat. Nauk (Tallin), v. 15, no. 1, 1966 p 37–45
(AD-678720; FTD-HT-23-1343-67) Avail: CFSTI CSCL 7/3

An evaluation is made of the experimental conditions that must be considered in quantitative impurity determinations in the 0.01 to 0.000001 range with a gas chromatograph. In this evaluation particular attention is given to flame parameters (gas velocities and electrode voltages) and detector linearity. The dependence of detector response on molecular structure and, in particular, on various functional groups is investigated for a variety of compounds. It is shown that even moderate thermal cracking between the column and the flame has a profound effect on the detector response. A practical prescription for impurity determination with flame-ionization detectors is given. Author

N69-16319# Sandia Corp., Albuquerque, N. Mex.
TRACE METAL ANALYSIS IN WATER BY ATOMIC ABSORPTION SPECTROPHOTOMETRY
J. P. Grillo Sep. 1968 30 p refs Supported in part by AEC
(SC-TM-68-587) Avail: CFSTI

The analysis by atomic absorption spectroscopy of Cd, Cr, Cu, Fe, Mn, Pb, and Zn in water is discussed, particularly in the concentration range of concern to water pollution chemists. Of particular interest is the discussion of the limit of sensitivity for these seven elements in the parts-per-billion concentration range. The direct aspiration of the water sample into the atomic absorption flame for analysis of the metals studied seems to warrant further work toward acceptance as a standard method for trace metal contaminant analysis. Author (NSA)

N69-16323# Ballistic Research Labs., Aberdeen Proving Ground, Md.
DECAY KINETICS OF THE METHYL RADICAL PRODUCED BY ULTRAVIOLET IRRADIATION OF METHANOL-WATER MATRICES AT 77 K
C. Morgan Oct. 1968 25 p refs
(AD-678563; BRL-1422) Avail: CFSTI CSCL 7/4

Methyl radicals have been produced in methanol-water matrices at 77K by ultraviolet irradiation. The decay of the electron spin resonance spectra of the radical has been studied as a function of methanol concentration. It was found that the decay can be best explained by three parallel reactions, two of these reactions also being series reactions. Author (TAB)

N69-16328# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
OBSERVATIONS ON THE EFFECT OF SELECTED ORGANIC MATERIALS ON THE USABLE POTENTIAL RANGES OF THE GLASSY CARBON, PYROLYTIC GRAPHITE, AND PLATINUM ELECTRODES
Carl E. Plock 26 Sep. 1968 2 p refs
(Contract AT(29-1)-1106)
(RFP-1221) Avail: CFSTI

The effect of several organic materials on the usable potential ranges of the glassy carbon, pyrolytic graphite, and platinum wire electrodes is reported. Author (NSA)

N69-16329 Saskatchewan Univ., Saskatoon.
POTENTIOKINETIC INVESTIGATION OF THE ANODIC BEHAVIOUR OF BRASS
Nooruddin Ahmed (Ph.D. Thesis) 1968 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-9724

The aim of the present work was to record and interpret the potentiokinetic anodic polarization characteristics of 85/15 and 60/40 brass in neutral, acidic, and alkaline chloride and sulfate solutions and also in sodium hydroxide solutions. Thests were made in nitrogen saturated aqueous solutions using a potential scan rate of 1 volt/min. All tests were conducted at a temperature of 25 ±1°C. An all glass cell with ground glass joints and a saturated calomel electrode as reference electrode were used. Potential versus current plots were recorded directly using an X–Y plotter. By proper calibration the current scale was rescaled to current density. A technique for mounting brass sample electrodes, suitable for the glass cell, was developed so that only a flat surface of 1 cm diameter was exposed to the test solution. Dissert. Abstr.

N69-16330# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF POLYMERS BY GAS–LIQUID CHROMATOGRAPHY USING AN INTERNAL STANDARD
L. P. Gratsianskaya et al 14 Dec. 1967 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk Kaz. SSR, Ser. Khim. (Alma-Ata), no. 1, 1965 p 86–88
(AD-678621; FTD-HT-23-1200-67) Avail: CFSTI CSCL 7/3

Gas-liquid chromatography with an internal standard was used to detect the high-boiling part of the essential oils and polymers formed by catalytic isomerization of pinene and camphene. Cineole and menthol were used as internal standards. Results are compared with data obtained by the fractional distillation at reduced pressure. Author (TAB)

N69-16360 Washington Univ., St. Louis, Mo.
CARBON DEPOSITION IN POROUS MEDIA BY THE THERMAL DECOMPOSITION OF METHANE
Roger Allen Schwind (Ph.D. Thesis) 1968 247 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.20 Order No. 68-10798

An analytical and experimental study has been made of the effects of carbon deposition resulting from the thermal decomposition of methane in porous graphites and carbons. Methane and inert gas mixtures were passed through cylindrical samples of carbon and graphite which were brought to an elevated temperature by induction heating. Carbon deposition experiments were carried out over the temperature range from 1400°K to 2500°K. The changes in the permeability, porosity, and pore size distribution of the porous media which resulted from the carbon deposition process were determined experimentally. Photomicrographs were taken to give a qualitative understanding of the carbon deposition process. The composition of exit gases which passed through the porous media was studied by means of a gas chromatograph as a check on the kinetic model used in the analysis. Analytical methods were developed to predict the changes in permeability as a function of time and position within the medium resulting from carbon deposition. Dissert. Abstr.

N69-16370# Army Nuclear Defense Lab., Edgewood Arsenal, Md.
MEASUREMENT OF X-RAY PULSES BY CHEMICAL MEANS
Nathan Klein, James E. Fanning, Jr., and Thomas L. Smith Sep. 1968 40 p refs
(AD-678581; NDL-TR-115) Avail: CFSTI CSCL 7/5

This report describes a technique for measuring the size and shape of an X- or gamma-ray pulse. The technique is based on water and dilute aqueous solutions that, when irradiated, produce the hydrated electron, e(aq)(-), a short-lived, transient ion with an intense optical absorption spectrum. Measurements of the intensity of red light transmitted through the irradiated sample are directly correlated to radiation intensity. Resolving time of the system is in the nanosecond range. The technique is shown to be feasible and may have application at pulsed accelerator facilities and at nuclear weapons tests. Author (TAB)

N69-16399 Princeton Univ., N. J.
LASER PHOTOCHEMISTRY
Denis Lawrence Rousseau (Ph.D. Thesis) 1967 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-8958

Chemical reactions induced by the simultaneous absorption of two photons are considered using samples irradiated with a ruby laser. Irradiation of crystalline AgCl with a normal burst output beam at 6943 Å resulted in molecular dissociation in addition to visible luminescence. The power dependence of the luminescence indicated that decomposition resulted from a two photon absorption. Containers with transparent dielectric windows were used to study liquid and gas phase reactions involving the emission of charged particles. It was found that particulate contaminants made the most significant contribution to this emission. Both gaseous and liquid samples of azoethane were irradiated, but no decomposition resulting from two-photon absorption could be observed in either phase. In the liquid phase decomposition to products similar to those produced by thermal and ionization processes was seen which resulted from surface contaminants on the windows of the cell. The conclusion reached was that at the present time the general utility of multiphoton photochemistry is extremely limited. Dissert. Abstr.

N69-16429# California Univ., Los Angeles. Dept. of Chemistry.
RADIATIONLESS LOSS MECHANISM AND INTERMOLECULAR INTERACTIONS Final Report, 1 Oct. 1965–30 Sep. 1968
A. El-Sayed Nov. 1968 12 p refs
(Contract Nonr-4756(07); ARPA Order 306)
(AD-679239) Avail: CFSTI CSCL 7/5

Final report on three-year contract period: studies in radiationless loss mechanisms and intermolecular interactions, with details of work on phosphorescence emission in crystals, the effect of shallow traps on the triplet-triplet annihilation process at very low temperature, radiative and nonradiative properties of the individual multiplets of the lowest triplet state, and discussion of the field of triplet state spectroscopy. Author (TAB)

N69-16430# Washington Univ., Seattle. Dept. of Chemistry.
COMPETITIVE UNIMOLECULAR DECOMPOSITION IN CHEMICALLY ACTIVATED RADICAL SYSTEMS. ISOPROPYL RADICAL RUPTURE
B. S. Rabinovitch and C. W. Larson 1 Nov. 1968 30 p refs Submitted for publication
(Contract Nonr-477(36))
(AD-678745; TR-11) Avail: CFSTI CSCL 7/4

Detailed study has been made of the competitive unimolecular decomposition of several chemically activated radicals: 2-methyl hexyl-3, 4-dimethyl pentyl-2 and 5-methyl hexyl-3. These decompose by C-C bond ruptures to give isopropyl and methyl radicals. Disproportionation-recombination ratios of the various radicals were measured. The value of D(Iso-Pr-H) is determined to be 12.7 kcal/mole. The rate data are examined on a theoretical model. A summary of bond dissociation values determined by the present method is given. Author (TAB)

N69-16439# Forsvaret Forskningsanstalt, Stockholm (Sweden).
THERMOCHEMICAL CALCULATIONS FOR A ROCKET MOTOR USING THE COMPONENTS AVIATION GASOLINE MC 77 AND FUMING NITRIC ACID [TERMOKEMISKA PRESTANDABERAEKNINGAR PA ETT RAKETDRIVMEDEL MED KOMPONENTERNA FLYGBENSIN MC 77 OCH VITRYKANDE SALPETERSYRA]
S. E. Flygar Aug. 1967 22 p refs In SWEDISH
(FOA-2-A-2491-42) Avail: CFSTI

The calculations were made for eight different mixture ratios and with combustion chamber pressures varying between 25 and 90 bar. The results are shown in tables and diagrams. Author

N69-16453 Michigan Univ., Ann Arbor.
ELECTRON SPIN RESONANCE OF PARAMAGNETIC TUNGSTEN AND NIOBIUM SUBSTITUTION IN CALCIUM TUNGSTATE
Keh-Chang Chu (Ph.D. Thesis) 1967 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-7575

The purpose of this study is to investigate the electron spin resonance (ESR) spectrum of specific calcium tungstate crystals after reactor neutron or cobalt-60 gamma irradiation. Pure calcium tungstate crystals after reactor neutron irradiation of 10^{17} nvt show many ESR lines at room temperature and liquid nitrogen temperature. Two prominant groups of lines are identified as paramagnetic tungsten associated with calcium and oxygen vacancies respectively. Uniaxial stress experiments provide further support to this assignment. The measured number of oxygen vacancies is found in good agreement with the theoretical treatment of Kinchin and Pease. Niobium doped calcium tungstate crystals after Cobalt-60 gamma irradiation of 10^6 rads show prominent ESR lines at 77°K and 195°K. As the temperature decreases the spectrum is broadened at first and finally splits into four at 77°K. The average position of the low temperature spectrum is equal to the position of the high temperature spectrum. This temperature dependence is explained in terms of vibronic interaction. Dissert. Abstr.

N69-16484*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLYMER RESEARCH
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 98-119 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 07C

Semi-empirical correlations between solubility parameters and refractive indices for a series of model compounds are discussed in relation to evaluating polymeric materials for propellant expulsion bladders. Analytical nuclear magnetic resonance (NMR) results are given on cationic crosslinking agents, along with electron spin resonance data on cobalt γ-irradiated crosslinking agents. The radicals obtained during irradiation were identified by means of ESR, and the high stability of these materials under the influence of cobalt γ-radiation was established. To gather evidence for activated carrier mobility in organic solids, steady-state space charge limited currents were obtained at different temperatures for a series of dipyridylium model compounds into which tetracyanoquinodimethane, in the form of a radical ion, was introduced. It was concluded that the observed conductivity changes are due to mobility changes. Performance test data are given on an optical-cold mirror humidity sensing and controlling instrument for use in an ethylene oxide-Freon 12 atmosphere. An interpretation is presented on the volume-extension data reported for a noncrystallizable styrene-butadiene copolymer vulcanizate. M.G.J.

N69-16488*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHYSICS
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 149-160 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 07D

An ion cyclotron resonance (ICR) spectrometer was used to study the energy dependence of the ion-molecule reaction in gaseous HD. Comparisons between ICR and ion cyclotron double resonance (ICDR) techniques are drawn. A tabulation lists the observed H_2D^+/HD_2^+ ratio at various ICDR irradiating field strengths. Examples are given of chlorine isotope shifts on the fluorine-19 resonances in three molecules. From the fluorine linewidths in these three compounds, the relative magnitudes of electric field gradients at the chlorine nuclei were inferred. An overview is presented on two iterative-type computer programs written to reduce both the inaccuracy and the labor of retrieval of nuclear magnetic resonance (NMR) parameters extracted from complex spectra. An energy-level iterative NMR method is proposed for sets of magnetically nonequivalent, chemical shift equivalent nuclei. Consideration is also given to exterior forms and general relativity. A method of classifying solutions is discussed which consists of recasting the problem to that of finding certain integral surfaces of closed systems of exterior differential forms in a space of n dimensions, where n-p is the number of dependent variables, and p the number of independent variables of the original partial differential set. M.G.J.

N69-16496# Oak Ridge National Lab., Tenn.
INTERACTIONS OF REFRACTORY METALS WITH ACTIVE GASES IN VACUA AND INERT GAS ENVIRONMENTS
H. Inouye Oct. 1968 39 p refs
(Contract W-7405-ENG-26)
(ORNL-4312) Avail: CFSTI

The state of our knowledge of the interactions of refractory metals with active gases in vacuum and inert gas environments is reviewed. At temperatures from 600 to 2000°C and at pressures from 10^{-3} to 10^{-10} torr, contamination, degassing, decarburization, and sublimation reactions occur between the refractory metals and absorbed gases. The extent and kinetics of these reactions are governed by the deviation of the interstitial concentration of the refractory alloy from the equilibrium concentration dictated by the temperature and pressure of the active gas. The reaction rates in inert gases are equivalent to vacua of approximately 10^{-5} to 10^{-7} torr. These interactions can be reduced by minimizing the surface-to-volume ratio of the metal and minimizing the degree of equilibrium disparity. Added control is gained by the use of barrier foil envelopes and the use of low-pressure CH_4 to neutralize the oxidizing gases. Author (NSA)

N69-16526 Pennsylvania State Univ., University Park.
GAS PHASE STUDIES IN ELECTRON PARAMAGNETIC RESONANCE
Mildred May Maguire (Ph.D. Thesis) 1967 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-8721

Three independent investigations were conducted to: (1) produce hydrocarbon free radicals by mercury photosensitization and study the hyperfine interactions in the hydrocarbon radicals; (2) study quadrupole-quadrupole interactions between oxygen and foreign gases through O_2 EPR line broadening by foreign gases; (3) investigate the kinetics of mercury photosensitized decomposition of N_2O. Investigation (1) resulted in intense triplet resonances at g=2, produced from a microwave discharge through mercury vapor

mixtures, which did not arise from free radicals in the system. They correspond to excitation and de-excitation of electron plasma oscillations near the electron cyclotron frequency. Paraffin gases yielded no multiple resonances, and experiments with low pressure mercury resonance lamps produced no detectable concentrations of free radicals. Study (2) revealed that O_2 EPR line broadening by foreign gases can be used as a probe to ascertain quadrupole–quadrupole interactions between oxygen and the foreign gas, and that a linear relationship is obtained between O_2 line broadening and the molecular quadrupole moment of foreign gases. Study of mercury photosensitized decomposition of N_2O indicates that the decomposition is first order and that the first order rate constant is $k = 0.002$ sec $^{-1}$. Dissert. Abstr.

N69-16527 Washington Univ., Seattle.
ELECTRONIC BAND STRUCTURE AND OXYGEN POTENTIAL IN THE SYSTEM Zr–C–O
Alan Dale Miller (Ph.D. Thesis) 1967 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-9311

The electronic band structures of a series of compositions corresponding to substitutional oxygen solubility in the ZrC lattice were calculated using a modified tight-binding approach. The two-center integrals necessary for the calculation were estimated from values found for similar materials. The band structures indicate that compositions with up to 50 percent oxygen substitution for carbon in the lattice remain metallic conductors. A calculation of the relative cohesive energy as a function of composition shows a minimum near 35 percent oxygen substitution. This behavior supports the presence of a ternary compound in the system. An experimental study of the oxidation of ZrC by low oxygen potential atmospheres was conducted in atmospheres with oxygen partial pressures between 10^{-6} atmospheres and 10^{-18} atmospheres at temperatures from 1100° to 1550°C. Two carbon monoxide pressures were used, one atmosphere and 0.033 atmospheres. No information as to the existence of the compound Zr_2CO was found, but very low solubilities of carbon in ZrO_2 and oxygen in ZrC under these conditions were evidenced. Dissert. Abstr.

N69-16533 Princeton Univ., N. J.
ELECTRON SPIN RESONANCE AND CHEMILUMINESCENCE STUDIES OF SHORT-LIVED SPECIES IN AQUEOUS SOLUTIONS
Daniel James Mickewich (Ph.D. Thesis) 1968 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-9687

Intermediates formed in the decomposition of hydrogen peroxide in several systems are compared using electron spin resonance (ESR) coupled with flow methods. The reaction of titanium(III) chloride and hydrogen peroxide is described in most detail. The low value of the rate constant for radical recombination is used to suggest that the species observed is of greater molecular complexity than HO_2 or OH free radicals. This hypothesis is supported by the behavior of the steady state concentration in the presence of added substances, referred to as scavengers. No signal could be found in the decomposition of H_2O_2 by Fe(II) suggesting a very short lifetime for uncomplexed OH. The ESR spectrum of dilute uv irradiated H_2O_2 stabilized on vycor glass is presented. Methyl radicals are observed in the reaction of t-butyl hydroperoxide and Ti(III). These are not stabilized by scavengers or Ti(IV). The ESR spectrum and decomposition kinetics of potassium tetraperoxychromate(V) in aqueous solution at pH 11.7 are presented. An image intensifier and flow system were used to study the very weak chemiluminescence produced in the Ti(III)-t butyl hydroperoxide system. A broad spectrum centered at 4800°A was obtained using filters. The light production is explained by means of the reaction of dissolved molecular oxygen and free radicals. Dissert. Abstr.

N69-16534 Wisconsin Univ., Madison.
THE EFFECTS OF DENSITY, TEMPERATURE, AND CRITICAL PROPERTIES OF THE DIFFUSION COEFFICIENTS OF NONPOLAR GAS PAIRS
Liong Seng Tee (Ph.D. Thesis) 1968 317 p
Avail: Univ. Microfilms: HC $14.40/Microfilm 4.10 Order No. 68-5362

The effects of density, temperature, and critical properties on the mass diffusivity of nonpolar gas pairs were studied. Self-diffusion and binary diffusion were simulated experimentally by the diffusion of a radioactive tracer through a solvent gas. A Loschmidt diffusion cell with built-in ionization chambers was used for the diffusion tests. Experimental planning was guided by corresponding-states principles and dimensional analysis. Experimental conditions were selected to facilitate the development of a generalized correlation of self-diffusion and binary diffusion. Comparisons were made for the experimental results with related systems previously studied, and with predictions afforded by various semiempirical theories. In the comparison with theories, the best results were obtained with the Enskog theory used with PVT data. The Slattery–Bird reduced state correlation gave reasonably good results in most cases. Dissert. Abstr.

N69-16567 Illinois Univ., Urbana.
NUCLEAR MAGNETIC RELAXATION AND ATOMIC DIFFUSION IN ALUMINUM ALLOYS
Frank Yale Fradin (Ph.D. Thesis) 1967 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-8077

Measurements are presented of nuclear magnetic relaxation of Al^{27} in pure aluminum and aluminum base alloys containing either zinc, magnesium, silver, or germanium in concentrations between 0.1 and 5.0 atomic percent. From these measurements of spin lattice relaxation in the coordinate system rotating at the Larmor frequency of Al^{27}, a composition dependent activation energy for atomic diffusion and a composition dependent local field strength at the aluminum nucleus is determined and related to both the nuclear dipole–nuclear dipole interaction and the nuclear electric quadrupole interaction. In pure aluminum the activation energy for diffusion was found to be 28.7_5 kcal/mole. The low activation energy in the alloys was interpreted in terms of easy atomic motion near a solute atom. Dissert. Abstr.

N69-16595# Argonne National Lab., Ill.
BIBLIOGRAPHY OF CEN PYROMETALLURGICAL AND PYROCHEMICAL FUEL REPROCESSING WORK
J. Arntzen 15 Jan. 1968 45 p refs
(TID-24745) Avail: CFSTI

Two hundred and two references to work performed by the Chemical Engineering Division on high temperature fuel reprocessing are presented for 1953 through 1967. The references are listed chronologically by year and alphabetically by author within each year. The references are then cross-indexed by author. A listing of other reference sources is included. NSA

N69-16605# College of Aeronautics, Cranfield (England).
THE REACTION OF PERFLUOROGLUTARIC ACID WITH METHYL MAGNESIUM IODIDE, PART 2
D. A. Smith Aug. 1968 12 p refs
(CoA-Note-MAT-22) Avail: CFSTI

Perfluoroglutaric acid when treated with methyl magnesium iodide afforded hexafluoro-2, 6-dimethylpyran-2, 6-diol in high yield and 2, 2, 3, 3, 4, 4-hexafluoro-5-oxocaproic acid in low yield. The former appeared to exist in a range melting form 64° to 79°C) and also in a very labile form melting at 96° to 98°C. Problems associated with the formation of this latter form were investigated. The hexafluoro-2, 6-dimethylpyran-2, 6-diol yielded a

monosemi-carbazone and also a mono and a di(2, 4-dinitrophenylhydrazone). The mono (2, 4-dinitro phenylhydrazone) appeared to be cyclic. Reduction, both with lithium aluminium hydride and sodium borohydride yielded 3, 3, 4, 4, 5, 5-hexafluoro n heptane-2, 6-diol. Reaction with anhydrous calcium sulphate gave 3, 3, 4, 4, 5, 5-hexafluoro-2 methylcyclohex-1 ene-6 one. The acid product of the original reaction of perfluoroglutaric acid and methyl magnesium iodide was characterized as a 2, 4-dinitrophenylhydrazone and as an S-benzylthiouronium salt. Infrared spectroscopic evidence suggests the latter compound exists in a straight chain form. Author

N69-16612# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BACK CURRENTS IN A UNIPOLAR ARC

P. D. Korzh et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 9-16 refs (See N69-16610 06-34)

Avail: CFSTI

In view of the importance of this question to arc-flame chemical analysis of various ores and minerals, the conditions under which inverse current appears in a unipolar arc between carbon electrodes, and the conditions under which the unipolar arc changes into a bipolar one are tested experimentally. The presence of inverse current was detected by means of a calibrated watt-hour meter. Measurements were made of the dependence of the inverse current on the type of ore melted by the arc (blast furnace slag, iron ore, magnetic ore, magnesite, and other agglomerates), and of the temperature and material erosion of the carbon electrodes employed. The experimental results are interpreted from the point of view of the thermodynamic theory of arcs. It is proposed that a strictly unipolar regime can be obtained by using a unipolar double arc, one of the arcs serving for analysis, and the other to suppress the inverse current. A simple variant of such a system is described. Author

N69-16614# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF BROMINE AND IODINE IN POWDER SPECIMENS FROM VACUUM-REGION SPECTRA

M. V. Belobragina et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 24-29 refs (See N69-16610 06-34)

Avail: CFSTI

Methods of injecting nonconductive powder specimens containing halogens into the cloud of a low voltage pulse discharge in a vacuum are considered. It is shown that the halogen spectra can be obtained using two layered briquettes. The use of the spark spectrum resonance lines of bromine and iodine for analysis made it possible to detect contents down to 0.5 μg, which in combination with preliminary enrichment, corresponds to a relative sensitivity of 5×10^{-5}%. Author

N69-16615# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MICROSPECTRAL ANALYSIS OF THIN COATINGS ON WIRES

S. A. Gorbunov et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 30-36 refs (See N69-16610 06-34)

Avail: CFSTI

A procedure was developed for microspectral analysis of coatings; the possibility of changing the composition of the initial alloy during the course of its deposition on the wire was determined. A technique was developed for depositing such coatings. The tests were made on titanium-copper coatings 3 to 28 μ thick on molybdenum wires of 0.25 mm dia. The copper content was either 10% or 50%. The analysis procedure is based on dissolving the wire from under the coating with nitric acid and determining the distribution of the coating material. It is found that the copper is not uniformly distributed in the coating (there is more copper at the inner surface) and that most coatings contain 2 to 5% of molybdenum. Small amounts of aluminum (3 to 7%) from the corundum crucible used for the production of the coating were also detected. The results show conclusively that the initial composition of the coating material becomes altered by the coating process, in spite of the fact that the wire is at high temperature for only a short time (1 to 3 sec). This in turn affects the antiemission properties of the coating. The data are used to develop a procedure for producing optimal coating conditions. Author

N69-16616# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMODYNAMIC REACTIONS WITH CARBON POWDER IN EMISSION SPECTRAL ANALYSIS

A. A. Frishberg *In its* J. of Appl. Spectry. 17 Jan. 1968 p 37-40 refs (See N69-16610 06-34)

The thermochemical reactions that take place when samples are diluted with carbon powder are examined. The isobaric potentials of the possible reactions are given. It is shown that fractional distillation of the vapors of admixtures and the base does not always occur. Author

N69-16618# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXCITATION AND POPULATION OF THE 2s-2 AND 2p-4 LEVELS OF NEON

A. P. Voytovich et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 47-56 refs (See N69-16610 06-34)

Avail: CFSTI

The populations of the $2s_2$ and $2p_4$ levels of neon in the positive discharge trunk were determined at various pressures and currents. The populations were found by a method that eliminated the necessity of measuring absolute line intensities. The populations of the $2s_2$ level were calculated from the electron temperatures and concentration found by probe measurements. The results of the calculation are compared with experimental data. Conclusions are drawn regarding the mechanism of excitation of the $2s_2$ and $2p_4$ levels. Author

N69-16619# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INDUCED RAMAN SCATTERING IN THE PULSED MODE. 1: WEAK SCATTERING

P. A. Apanasevich *In its* J. of Appl. Spectry. 17 Jan. 1968 p 57-69 refs (See N69-16610 06-34)

Avail: CFSTI

On the basis of rate equations, calculations are made for a pulse of weak induced Raman scattering when the energy of the scattered radiation can be neglected in the overall energy balance. Expressions describing the dependence of the shape, position, and height of the scattering pulse, as well as its duration and spectral width, are derived as functions of the parameters of the driving laser, the scattering substance and the observation conditions. Author

N69-16621# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A STUDY OF THE LUMINESCENCE OF ACETYLATED CELLULOSE

M. Z. Gavrilov et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 76-82 refs (See N69-16610 06-34)

Avail: CFSTI

Certain luminescence properties of acetylated cellulose are studied as functions of the concentration of ester groups and the wavelength of the exciting radiation. Of the three luminescence bands that appear on excitation by radiation of certain wavelengths, the ultraviolet band has structure. A correlation is established

between the intensity of this band and the ester group content, together with qualitative similarity of the luminescence excitation spectra to the absorption spectra. The relative quantum yield of luminescence depends on the wavelength of the exciting radiation. It is assumed that the centers responsible for the UV luminescence are two nonequivalent types of acetyl radicals. Author

N69-16623# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF TEMPERATURE ON THE FLUORESCENCE OF SOLUTIONS OF AROMATIC AMINO ACIDS
L. G. Pikulik et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 92–98 refs (See N69-16610 06-34)
Avail: CFSTI

The temperature dependence of the absorption and fluorescence spectra and the excited state lifetimes of indole, aromatic aminoacids, and glyciltryptophan are investigated in the temperature interval of +20 to −183°C. It was stated that the temperature shifts of the spectra may be explained for indole, tryptophan, and glyciltryptophan on the basis of a relaxation mechanism or orientation interaction. Author

N69-16624# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE INFLUENCE OF METHYL SUBSTITUTION ON THE QUASILINE SPECTRA OF 1,2 BENZANTHRACENE AT 77°K
N. A. Fenina *In its* J. of Appl. Spectry. 17 Jan. 1968 p 99–105 refs (See N69-16610 06-34)
Avail: CFSTI

The quasiline fluorescence spectra and absorption spectra of 1,2-benzanthracene and its monomethyl derivatives in n-paraffins (heptane-nonane) at 77°K are obtained and analyzed. It is found that position of CH_3 group in 1,2-benzanthracene ring has considerable influence on its electronic levels, shifting the spectrum, and on its vibrational sublevels. The latter is manifested in a change of frequencies of normal vibrations especially at low frequencies. Author

N69-16625# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION AND ANALYSIS OF THE INFRARED ABSORPTION SPECTRUM OF 2,5-DIMETHYL-4-PHENYL-PYRIDINE
Ved Prakash Gupta *In its* J. of Appl. Spectry. 17 Jan. 1968 p 106–112 refs (See N69-16610 06-34)
Avail: CFSTI

The infrared absorption spectrum of the 2,5-dimethyl-4-phenylpyridine molecule is obtained in the range of 400 to 2000 cm^{-1}, and the values of the fundamental frequencies and the forms of normal vibrations are calculated by the valence-force scheme. Author

N69-16626# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFRARED SPECTRA AND ENOLIZATION OF THE SIMPLEST 1,3-DIKETONES
E. Ya. Gren et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 113–120 refs (See N69-16610 06-34)
Avail: CFSTI

Infrared spectra of the elementary unsubstituted 1,3-diketones are analyzed, making it possible to judge their keto-enol equilibrium. Enolizability of such 1,3-diketones greatly changes in the presence of a cyclic structure and depends on the ring dimension. The nature of IR spectra enol bands is discussed. Author

N69-16627# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF VALENCE VIBRATIONS OF NH GROUPS IN THE INFRARED SPECTRA OF BORON-ORGANIC AMINES
N. S. Fedotov et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 121–129 refs (See N69-16610 06-34)
Avail: CFSTI

The infrared spectra of 15 boron organic amines in different solutions were investigated in a wide concentration range. The frequency values of valence NH vibrations in these spectra are compared with some properties of the compounds studied: their tendency to dimerization and their ability to form hydrogen bonds. Author

N69-16628# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF *TERT*-BUTYL PERESTERS BY THE INFRARED SPECTROSCOPY METHOD
Yu. N. Anisimov et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 130–136 refs (See N69-16610 06-34)
Avail: CFSTI

The infrared spectra of six tertbutylperesters on the basis of aliphatic acids, tertbutylperbenzoate and their nonperoxide analogs were studied. An analysis of the spectra and attribution of the absorption bands to the oscillations of the corresponding bonds and atom groups was performed. Force constants of the carbon–oxygen bonds were calculated and compared with corresponding values in molecules of related compounds. The possibility was shown of using the 1190 ± 1136 ± 4 and 1075 ± 5 cm^{-1} absorption bands in combination with characteristic absorption of the carbonyl groups of 1780 cm^{-1} for identification and the analysis of tertbutylperesters of aliphatic acids. Author

N69-16635# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DELOCALIZATION OF THE UNPAIRED ELECTRON IN THE MOLECULES OF COPPER PORPHIN COMPLEXES
Yu. V. Glazkov et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 167–170 refs (See N69-16610 06-34)
Avail: CFSTI

The ESR spectra of Cu-tetraphenylporphin and Cu-tetrachlorotetraphenylporphin were measured in dilute solutions of low viscosity and at 77°K. There is no substantial difference between the spectra of the two compounds. This shows that the unpaired electron in copper chelates of porphyrins is not delocalized over the whole conjugated bond system and the region of its delocalization is presumably limited by the four central nitrogens. Author

N69-16636# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USE OF AN ELECTRONIC COMPUTER TO AUTOMATE CALCULATIONS OF MASS SPECTRAL ANALYSIS
G. A. Sheynina et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 171–175 ref (See N69-16610 06-34)
Avail: CFSTI

A program is proposed to calculate automatically mass quantitative spectral analysis. The computer takes account of the spectrogram background, computes the parameter of calibration curve and the concentrations being determined. Control is provided for the calibration curve. It takes about two minutes to treat the photometration results of 160 spectra on the computer. Author

N69-16638# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFRARED ABSORPTION SPECTRA OF ETHANOLAMIDES OF FATTY ACIDS

I. A. Kozlov et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 180–183 refs (See N69-16610 06-34)
Avail: CFSTI

IR absorption spectra of the lauric acid etanolamides and their esters in a liquid paraffin (vaseline oil) have been studied. It is shown that these two compounds are associated at the expense of the intermolecular bonds. The amide group of monoetanolamides possesses transstructure. Author

N69-16640# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A HEATED METERING CUVETTE FOR SPECTRAL ANALYSIS
M. P. Yesel'son et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 188–190 refs (See N69-16610 06-34)
Avail: CFSTI

A self-metering cuvette for spectral analysis is described. This is used to melt highly viscous substances which are dissolved into solvents for measurements of their spectral characteristics. Author

N69-16641# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A COMBINATION MULTICHANNEL BURNER FOR FLAME PHOTOMETRY
S. Kh. Sheremet'yev *In its* J. of Appl. Spectry. 17 Jan. 1968 p 191–195 refs (See N69-16610 06-34)
Avail: CFSTI

Design details and test results are presented on a combination multichannel burner which permits the temperature and character of the flame to be varied over a wide range. The Meker burner serves as the basic construction, which combines the features of a burner for a diffusion-type flame and a burner for a premixed-gas flame. Flame temperature is regulated by injecting the required volumes of oxygen or nitrogen directly into the combustion zone of the combustible gas–air mixture. This makes it possible to ensure that the system spraying the solution to be analyzed can function independently of manipulations related to adjusting the burner operating mode. Author

N69-16642# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIENCE IN THE USE OF ELECTRODELESS SPECTRAL TUBES
M. M. Katsman et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 196–200 refs (See N69-16610 06-34)
Avail: CFSTI

Electrodeless high frequency tubes, that combine the merits of arc- and glow-discharge tubes with satisfactory service life, are discussed. In these tubes, the envelope is a glass or quartz sphere with a sealoff. The spherical envelope contains a certain quantity of a metal and an inert gas. The discharge is excited in the tube by vibrational motion of electrons in a high frequency electromagnetic field. Design requirements for the radiator block (the combination of the oscillator and the discharge tube) are listed, and a structural diagram is included. Experience in the use of the electrodeless tubes shows that they may be used extensively in optical analytical instrumentation, but that further work will be necessary to improve their operational reliability. Author

N69-16649 IIT Research Inst., Chicago, Ill.
DYNAMICS OF FIXED BED ADSORBERS
Chang Whan Chi (Ph.D. Thesis) 1968 274 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.55 Order No. 68-7781

In this study, generalized mathematical models for a single adsorbate component present in a gas have been developed for isothermal and adiabatic dynamic adsorption–desorption processes. These models incorporate an overall resistance–linear driving force concept. They are applicable to both an unsupported adsorbent bed and a fixed bed of adsorbents impregnated on a supporter which may have nonlinear equilibrium relationships. The partial differential equations governing the dynamic adsorption–desorption processes and the nonlinear equilibrium relations were solved numerically on the digital computer. The accuracy of the numerical solutions has been tested in the limiting cases by comparing them with the analytical solutions of Anzelius for isothermal adsorption and with the numerical results attained by Bullock for the adiabatic adsorption of water vapor by an unsupported adsorbent bed. Dissert. Abstr.

N69-16652 Columbia Univ., New York.
THERMODYNAMIC AND TRANSPORT PROPERTIES OF THE ALKALI METAL VAPORS. PART 1: EXPERIMENTAL MEASUREMENT OF VISCOSITY. PART 2: THEORETICAL CALCULATION OF COLLISION INTEGRALS, VISCOSITY AND DIFFUSIVITY. PART 3: THE VIRIAL EQUATION OF STATE, AND ESTIMATION OF THE CRITICAL POINT
Do Ik Lee (Ph.D. Thesis) 1967 262 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 68-8592

The viscosities of cesium, rubidium, potassium, and sodium vapors were measured up to 1000°C over a pressure range of 0.4 to 5 atm at maximum by a steady flow high-temperature coiled capillary viscometer. They were correlated with the mole fraction of dimer for convenient interpolation and extrapolation, on the basis that the alkali metal vapors are mixtures of monomer and dimer only. The most-likely potential energy curves for the singlet and triplet states of hydrogen atoms were constructed from the best data presently available, and were used to obtain those of the alkali metal atoms by a semi-empirical scaling procedure. The second and third virial coefficients were calculated from the scaled potential energies. The critical properties of the alkali metals were estimated by using the corresponding states relations based on the molecular constants and scaling factors. Dissert. Abstr.

N69-16669# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
DISSOCIATIVE PHOTOIONIZATION OF MOLECULAR OXYGEN
P. H. Doolittle, R. I. Schoen, and K. E. Schubert Oct. 1968 38 p refs
(AD-679379; DI-82-0757) Avail: CFSTI CSCL 7/4

Energy distributions of the ions produced in the dissociative photoionization of O2 have been measured with photons in the spectral interval 584 A to 358 A. Tentative identification of several ion groups with particular states of the O2(plus or minus) molecular ion have been made. Mass spectrometric measurements were carried out with a pulsed, slitless mass spectrometer to identify the ions produced with 584 radiation and to confirm the production of energetic ions. It is concluded that mass spectrometer discrimination against energetic ions may have caused an underestimate of the amount of dissociative photoionization produced by wavelengths shorter than 584 A. Author (TAB)

N69-16682 Minnesota Univ., Minneapolis.
APPLICATION OF THE ROTATING RING-DISC ELECTRODE TO THE STUDY OF HETEROGENEOUS AND HOMOGENEOUS REACTIONS
Dennis Charles Johnson (Ph.D. Thesis) 1967 336 p
Avail: Univ. Microfilms: HC $16.30/Microfilm $4.30 Order No. 68-7414

The rotating ring-disc electrode was found to be useful for the study of heterogeneous and homogeneous reactions. Experiments usually involve the simultaneous measurement of current

flowing in the ring and disc electrode, while maintaining the potential of one electrode constant with respect to a reference potential and varying the other in a prescribed manner. Instrumentation for simultaneous and independent potential control of each electrode was developed and constructed. Voltammetry using the ring-disc electrode was used to characterize the oxidation and reduction reactions of platinum in 1.0 M sulfuric acid. It was found that production of soluble electroactive species accompanies both the anodic and cathodic processes. The amount of these species produced was found to be negligible in comparison to the number of coulombs required to oxidize and reduce the electrode. Dissert. Abstr.

N69-16687 Ohio State Univ., Columbus.
CHRONOPOTENTIOKINETIC STUDIES OF THE PASSIVATION OF HIGH-PURITY AND SULFURIZED IRON IN 1-NORMAL H SUB 2 SO SUB 4
James Earl Reinoehl (Ph.D. Thesis) 1967 337 p
Avail: Univ. Microfilms: HC $15.30/Microfilm $4.35 Order No. 68-8869

The electrochemical and kinetic fundamentals which serve as bases for anodic polarization corrosion studies, the present state of knowledge about passive and transpassive phenomena and the effect of physical, chemical and experimental variables on anodic polarization are reviewed. Potentiokinetic and potentiostatic pulse data are reported for single crystal and polycrystalline specimens of high-purity and sulfurized (150 ppm S) iron in 1N H_2SO_4. The interdependence of time, potential and current in the passive and transpassive behavior of these materials is shown. Potentiokinetic and potentiostatic pulse data are compared by means of continuous-scanning-transformation (CST) and time-potential-transformation (TPT) diagrams. The shape of potentiokinetic anodic polarization curves has been found to vary appreciably and reproducibly with polarization rate. At faster polarization rates, current densities tended to be higher and secondary passivity more pronounced. Dissert. Abstr.

N69-16696 National Lending Library for Science and Technology, Boston Spa (England).
INORGANIC ION EXCHANGE MATERIALS [NEORGANICHESKIE IONOOBMENNIKI]
E. A. Materova et al Oct. 1968 59 p refs Transl. into ENGLISH from Russian
(NLL-RTS-4816) Avail: Natl. Lending Library, Boston Spa, Engl.: 40s

The ion exchange properties of different types of inorganic materials and the possibilities of using these for ion separation are investigated. Inorganic materials for this purpose have become increasingly important as substitutes for complex-forming ion exchange resins due to their high selectivity and stability to high temperatures and radiation. Natural and synthetic aluminosilicate materials, divided into three groups according to crystal structure, are described. Feldspars and zeolites of all three groups occur, based on various combinations of silicon–oxygen and aluminum–oxygen tetrahedra. Also reviewed are materials based upon Groups III–VI of the Periodic Table, including the hydroxides of a number of metals and combinations of oxides of Group IV with the more acidic oxides of Groups V and VI. The salts of polybasic acids are of particular interest, since these compounds easily form polymeric chains, limited by their low solubility. Ion exchange materials based on zirconium are also reviewed, with emphasis on zirconyl phosphate compounds. A.C.R.

N69-16697 National Lending Library for Science and Technology, Boston Spa (England).
RADIATION CROSS-LINKING OF POLYOLEFINS IN THE PRESENCE OF SULPHUR MONOCHLORIDE [RADIATSIYINOKHIMICHNE ZSHIVANNYA POLIOLEFINIV V PRISUTNOSTYI MONOKHLORISTOYI SIRKY]
H. K. Kaurkova et al Oct. 1968 5 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 9, 1965 p 1183–1185
(NLL-RTS-4839) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d

The possibility of reducing the radiation dosage required to cause crosslinking of polyolefins was investigated by conducting the reaction in the presence of a crosslinking agent, sulfur monochloride. Tests were made on films, 60 μ thickness, from nonstabilized high density polyethylene and on filaments, 180 μ diameter, from polypropylene. The treatment of the polyolefins by sulfur monochloride was affected from the vapor phase, with irradiation by gamma rays from a Co^{60} source at dose rate of 100 rad/sec. The tensile strength of the polypropylene filaments, after absorption of 5 or 10 percent of the S_2Cl_2 and irradiation at doses from 0.25 to 7.0 Mrad, was higher in all cases than that of the control specimens, particularly at high temperatures. Similar reactions occured with the polyethylene films. In external appearance and elasticity, the modified material was barely distinguishable from the original polymer. Control tests indicated that sulfur monochloride in itself, without subsequent irradiation, does not lead to crosslinking of the polymer. A.C.R.

N69-16730# IIT Research Inst., Chicago, Ill.
ADVANCED OXIDIZER CHEMISTRY Technical Summary Report, 1 Aug.–30 Sep. 1968
Irvine J. Solomon 8 Nov. 1968 13 p refs
(Contract F44620-68-C-0039)
(AD-678630; IITRI-C6135-3; AFOSR-68-2646) Avail: CFSTI CSCL 7/3

Attempts were made to prepare pure CF3CF2CF2OOF by the reaction of c-C3F6 and O2F2, however, the reaction is not simple and success has not yet been achieved. Author (TAB)

N69-16737# Dynamic Science Corp., Monrovia, Calif.
HEAT RELEASE RATE FOR THE LIQUID NITROGEN TETROXIDE/HYDRAZINE REACTION BY SOMOGYI AND FEILER'S METHOD Final Report, 19 Jan.–12 Apr. 1968
B. R. Lawver and E. A. Tkachenko 12 Apr. 1968 15 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952197)
(NASA-CR-73608; SN-114) Avail: CFSTI CSCL 7D

The heat release rate for the liquid phase reaction of nitrogen tetroxide and hydrazine was measured. The basic method and apparatus employed were those of Somoguyi and Feiler. An important modification of the apparatus as employed in the present study consists of an arrangement to measure directly the driving piston velocity. Prior to carrying out measurements for the system N_2O_4/N_2H_4, the propellant combination HNO_3/N_2H_4 was utilized to check out the apparatus. The heat release rate values for N_2O_4/N_2H_4 obtained in this study were found to depend on injection velocity. The range of heat release rate values for the system N_2O_4/N_2H_4 found in this study is very nearly the same as that determined by Somogyi and Feiler for HNO_3/N_2H_4. Author

N69-16741 Case Western Reserve Univ., Cleveland, Ohio.
APPLICATION OF LASER HOMODYNE SPECTROMETER TO PARTICLE SIZE MEASUREMENTS
John Walcott Dunning, Jr. (Ph.D. Thesis) 1967 202 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 68-10153

The first successful size measurements of particles in dispersions using the Doppler shift of scattered laser light were made. The new method permits particle size measurements of

monodisperse systems or average particle size measurements of polydisperse systems in the size range from 50°A to 3μ. This includes particles too small to measure with normal light scattering techniques. The results indicate that it is possible to obtain quantitative data on the dynamics of small particles and that it is possible to relate the spectrum of scattered light to a space-time correlation function. A He-Ne laser light source and high resolution optical homodyne detection were used to determine the spectra of light scattered from 800Å, 1435Å, and 2080Å diameter monodisperse polystyrene spheres at temperatures from 23°C to 50°C. The spectral line shape and the dependence of the halfwidth of the spectra on temperature and particle size agreed with theoretical predictions based on a random walk model for the motion of the spheres. Dissert. Abstr.

N69-16749# White Sands Missile Range, N. Mex.
A GENERALIZED EQUATION FOR DROPLET GROWTH DUE TO THE SOLUTION EFFECT
Richard D. H. Low Sep. 1968 28 p refs
(AD-679023; ECOM-5210) Avail: CFSTI CSCL 7/4

The fundamental parameter generally accepted in physical chemistry to account for the departure of a solution from ideality due to ionic dissociation and other causes is the mean ionic activity coefficient of the solute, rather than the vant Hoff factor commonly used in the literature and textbooks on cloud physics. It is directly related to many properties of a solution, one of which is the lowering of vapor pressure. The data on the activity coefficient of various electrolytes (or salts) are abundant and readily available; therefore it is fitting to express the equation for the solution effect on droplet growth in terms of this important parameter. A table is presented which gives the activity coefficients, the practical osmotic coefficients, and the vant Hoff factors of several salts in different concentrations. It is then shown that the generalized equation can be readily and exactly reduced to the expression derived by Byers for all concentrations and approximately to those given by Mason and Fletcher for very dilute solutions. Author (TAB)

N69-16752 Missouri Univ., Kansas City.
INTERFACIAL POLYMERIZATION WITH PHENYLPHOSPHONIC DICHLORIDE AND HYDROQUINONE
Charles Eugene Carraher, Jr. (Ph.D. Thesis) 1968 157 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-9848

The interfacial polycondensation of phenylphosphonic dichloride and hydroquinone was studied as a function of mole ratio of comers, concentration of comers, volume of organic and aqueous phase, nature of organic solvent, pH, temperature, ion concentration in aqueous phase, nature of reagent base or buffer in the aqueous phase, stirring rate, and presence of insoluble and inert particles in the reaction system, in order to determine the effect of these variables on polymer yield and molecular weight. Possible involved factors in the polycondensation of phenylphosphonic dichloride and hydroquinone which may affect reaction rate are discussed in terms of the influences of the above variables on molecular weight and yield. In systems in which base degradation, acid chloride hydrolysis and hydroquinone oxidation are relatively unimportant and stirring is held constant, there may exist three important factors. They are polymer formation, polymer precipitation and comer diffusion to the interface. Dissert. Abstr.

N69-16754 Florida Univ., Gainesville.
INVESTIGATION OF METHODS FOR CALCULATION OF INTERDIFFUSION COEFFICIENTS
Terrence Bradford Lindsmer (Ph.D. Thesis) 1968 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-9558

The determination of concentration-dependent interdiffusion coefficients in three-component metallic systems requires a large number of experiments. In an effort to reduce this number, three major mathematical methods were developed from the second Fick law of diffusion. With these methods more information about the interdiffusion coefficients can be obtained from a given experiment. The first method was developed from a form of the second Fick law that contains two unknowns. Two independent equations in these unknowns were established at the ends of a small interval of distance. The second method is based on the Boltzmann integration of the second Fick law. The third method is based on a second integration of the second Fick law. Dissert. Abstr.

N69-16759# Aerospace Corp., El Segundo, Calif. Lab. Operations.
VACUUM ULTRAVIOLET PHOTOLYSIS OF POLYDIMETHYLSILOXANE: GAS YIELDS AND ENERGY TRANSFER
Seymour Siegel and Thomas Stewart Aug. 1968 28 p refs
(Contract F04695-67-C-0158)
(AD-678510; TR-0158(9250-01)-7; SAMSO-TR-68-408) Avail: CFSTI CSCL 7/5

A polydimethylsiloxane polymer was irradiated with 1470 A and 1236 A radiation, and the quantum yields of the gas products were determined. Analysis of the data indicates that the breaking of the Si-CH3 bond is the most probable reaction occurring at both wavelengths. For surface irradiations, C2H6, CH4, and H2 are primary products, while for immersion irradiations, only CH4 and H2 are produced. The differences in the two types of experiments are ascribed to the competition between bimolecular CH3 combination and radical abstraction reactions; the surface irradiation favors the former mechanism. A mixed methyl-phenyl polymer ((CH3) (phi)2Si-O-Si(CH3)2 - O - Si (CH3) (phi)2) was also irradiated at 1470 A. No C2H6 was found for this polymer. Also solutions of the phenyl-containing polymer in the polydimethylsiloxane were irradiated. It was found that the gas yields were reduced by both radical addition to the phenyl groups as well as intermolecular energy transfer between the two polymers; however, there is no evidence for the presence of long-range transfer involving energy transfer along the chain. Analysis of the data indicates that the rate constant for H atom addition to a phenyl group is approx. 10 times larger than the corresponding rate constant for CH3 radicals. Author (TAB)

N69-16770 Oklahoma State Univ., Stillwater.
THE LEIDENFROST PHENOMENON FOR BINARY LIQUID SOLUTIONS
Edward Stanley Gotleski (Ph.D. Thesis) 1967 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-8406

Film boiling of discontinuous liquid masses on a flat plate was studied for ethanol-water, ethanol-benzene, and benzene-toluene solutions over the complete composition ranges. Initial liquid volumes ranged from 0.006 to 8 cm^3, and plate surface temperatures were varied from 150 to 450°C. All tests were made in the atmosphere. Total evaporation times for the masses were measured. The Leidenfrost point and the smallest liquid volume for which vapor bubbles break through the mass were determined. Liquid composition changes during evaporation were measured for the ethanol-benzene and benzene-toluene solutions. An analytical model was developed for predicting the total evaporation time and instantaneous composition of binary liquid drops. Dissert. Abstr.

N69-16778 Michigan Univ., Ann Arbor.
DETERMINATION OF MECHANISMS CAUSING AND LIMITING SEPARATIONS IN COLUMN CRYSTALLIZATION
Walter Collins Gates, Jr. (Ph.D. Thesis) 1967 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-7604

The process of column crystallization was analyzed mathematically and experimentally in order to determine the

mechanisms by which separations are achieved and limited. The results of the study indicate that, at total reflux, separation is produced by the formation of crystals in the freezing section and by interphase mass-transfer in the adjacent purification section. The separation is mainly limited by eddy diffusion in the liquid phase. Dissert. Abstr.

N69-16787 Oklahoma State Univ., Stillwater.
VOLUMETRIC PROPERTIES AND VIRAL COEFFICIENTS OF THE METHANE-ETHYLENE SYSTEM, USING THE TECHNIQUE OF ISOCHORIC CHANGES OF PRESSURE WITH TEMPERATURE
Henry Grady McMath, Jr. (Ph.D. Thesis) 1967 247 p
Avail: Univ. Microfilm: HC $11.25/Microfilm $3.20 Order No. 68-8460

An isochoric PVT apparatus was developed for the determination of precise volumetric data. The apparatus was operated at the temperatures 77, 60, 40, and 20°F, with pressures from 260 to 2400 psia. Compressibility factor data was taken for methane, ethylene, and four intermediate mixtures; and virial coefficients were derived from the data. The compressibility factor data and the virial coefficients were compared versus empirical equations of state. For the methane-ethylene system four rules were tested for the estimation of interaction second virial coefficients from the pure component coefficients. Mixture virial coefficients were then recalculated and compared with experimental values. Standard deviations from the four methods are summarized as: square root (6.2 cm^3/gm mole), Lorentz (8.3 cm^3/gm mole), linear square root (9.3 cm^3/gm mole), and linear (12.4 cm^3/gm mole). Dissert. Abstr.

N69-16794# New York State Univ., Syracuse. Coll. of Forestry.
A STUDY OF THE MECHANISM OF ELECTRON TRANSFER Technical Report, Jan. 1966-Jan. 1968
Michael Szwarc Wright-Patterson AFB, Ohio AFML Sep. 1968 98 p refs
(Contract AF 33(615)-3788)
(AD-679120; AFML-TR-68-250) Avail: CFSTI CSCL 7/4

This study is concerned with the development of conducting polymers. The report consists of six parts: Preparation of polymeric solvating agents and studies of equilibria between ion pairs and methoxylated polyethylene oxides (glymes). A brief study of conductance of SbCl6(-),CPh3(+) in CH2Cl2 demonstrated that neither of these ions interacts strongly with the solvent. Studies of ion pairs involving dihydroanthracene carbanions and Li(+) and Na(+) cations revealed interesting complexity of the ion pair system. These studies involved spectroscopic and NMR observations. We believe that heterocyclic polymers may provide a most suitable system for studies of conductance. We investigated, therefore, the UV and ESR spectra of a large series of N-heterocyclic aromatics and determined their electron affinities. In kinetic studies we demonstrated the formation of chemically solvated ion pairs, determined their state of solvation as well as the state of solvation of free ions. Finally, we started studies of ionization of aromatic monomers and the chemistry of the resulting radical ions. TAB

N69-16795# Mellon Inst., Pittsburgh, Pa.
A LOW TEMPERATURE RAMAN CELL FOR USE WITH THE CARY MODEL 81 LASER INSTRUMENT Summary Technical Report, 1 Mar. 1967-14 Mar. 1968
William G. Fateley and George L. Carlson Wright-Patterson AFB, Ohio AFML Oct. 1968 16 p refs
(Contract F33615-67-C-1416)
(AD-678855; AFML-TR-68-121) Avail: CFSTI CSCL 7/4

A simple low temperature cell for the measurement of Raman spectra of solids and condensed vapors down to -135C is described. The cell is designed for use with a Cary 81 Raman spectrometer using laser excitation. Spectra of diphosphine and phosphorus pentachloride are shown to illustrate the performance of the cell. Author (TAB)

N69-16815# Aerospace Corp., El Segundo, Calif. Lab. Operations.
TEMPERATURE EFFECTS ON THE PHOSPHORESCENCE OF AROMATIC HYDROCARBONS IN POLY (METHYL METHACRYLATE)
Peter F. Jones and Seymour Siegel Sep. 1968 29 p refs
(Contract F04701-68-C-0200)
(AD-678508; TR-0200(9250-01)-1; SAMSO-TR-68-404) Avail: CFSTI CSCL 7/5

Temperature effects on the phosphorescence lifetimes and phosphorescence intensities of naphthalene, phenanthrene, pyrene, biphenyl, and the perdeuterated analogs of these four molecules were measured with the use of poly (methyl methacrylate) (PMM) as a rigid solvent matrix. The phosphorescence lifetimes of these molecules decrease by only 13 to 37 percent upon warming from 77K to room temperature. On the basis of direct measurements of the permeability of PMM to oxygen, we conclude that oxygen quenching is not responsible for the observed temperature effects on the phosphorescence lifetimes. Although we cannot exclude the possibility that the rate constants for both radiative and nonradiative decay vary with temperature, we show that our results are consistent with an analysis that assumes that only the nonradiative rate constant is temperature dependent. On the basis of this analysis, we estimate an activation energy of 500 plus or minus 100/cm for the thermally activated nonradiative decay mode. Author (TAB)

N69-16854# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
ULTRASONIC PARAMAGNETIC RESONANCE OF TETRAVALENT URANIUM IN CALCIUM FLUORIDE
Perry Frank McDonald Jul. 1968 103 p refs
(AD-679042; RR-TM-68-1) Avail: CFSTI CSCL 7/4

The pulse-echo technique of ultrasonic paramagnetic resonance (UPR) was used at frequencies of 0.47-8.9 gigahertz and liquid helium temperatures to study the spin-lattice interaction between the U(4+) paramagnetic ion and a CaF2 lattice. A spin Hamiltonian is given which considers the effect of random strains on the UPR line shape. A spin-lattice Hamiltonian quadratic in spin and linear in strain was found applicable to the results. The G(ijkl) is the spin-lattice coupling tensor and epsilon kl is the strain due to an ultrasonic vibration. The frequency dependence of the UPR attenuation was studied in the range 1.1 to 8.9 gigahertz. The results agreed with the predicted dependence on frequency squared. The temperature dependence of the UPR attenuation was studied in the range 1.0 to 10.0K. Good agreement was found between the results and the theoretical dependence on 1/T. Author (TAB)

N69-16886*# California Univ., Berkeley. Sea Water Conversion Lab.
STUDY OF PERMEABILITY CHARACTERISTICS OF MEMBRANES Annual Report, 9 Nov. 1967-8 Nov. 1968
K. S. Spiegler, J. C. Th. Kwak, D. A. Zelman, and J. Leibovitz 9 Nov. 1968 52 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952109)
(NASA-CR-73602) Avail: CFSTI CSCL 07D

An apparatus for the measurement of membrane transport properties under the influence of electrical, osmotic, and pressure force is reported. This apparatus was built to (1) measure transport properties under the same conditions of concentration and solution agitation, and (2) incorporate suitable feedback mechanisms to keep the solution concentration constant in spite of the mass transfer which takes place. Transport is not measured by the difference of solution concentrations before and after the transport experiment, as is customary, but rather by the amounts of the

components added to the solutions (water or salt) by these feedback mechanisms. The performance of temperature regulation and concentration feedback mechanism was found to be adequate for most measurements. A set of experiments is outlined, based on transport parameter evaluation from the basic flux equations of linear non-equilibrium thermodynamics or on a transformed set of equations. Results of preliminary transport experiments are given.
Author

N69-16888# Office of Naval Intelligence, Washington, D. C. Translation Div.
INVESTIGATION OF LIQUID-GAS ELECTRODES. CAPILLARY LIQUID-GAS ELECTRODES OPERATING UNDER THE CONDITIONS OF NATURAL REMOVAL OF GASEOUS REACTION PRODUCTS [ISSLEDOVANIYE ZHIDKOSTNO-GAZOVYKH ELEKTRODOV KAPILLYARNYY ZHIDKOSTNO-GAZOVYY ELEKTROD V USLOVIYAKH YESTESTVEN-NOGO GAZOUDALENIYA]
N. V. Korovin et al 15 Aug. 1968 12 p refs Transl. into ENGLISH from Elektrokhimiya, v. 4, no. 4, 1968 p 426-431
(AD-679301; NIC-Trans-2669) Avail: CFSTI CSCL 7/4

Cathodic libration of hydrogen in a glass capillary on the surface of the nickel wire was investigated by means of motion picture and single frame photography, recording of the current and measurement of the potential difference. The size of the bubbles leaving the electrode surface has been determined. The dependence of the gas removal conditions on current density, tilt and widening of the capillary have been determined. The ohmic resistance of electrolyte under different conditions of gas removal has been measured.
Author (TAB)

N69-16914*# McDonnell-Douglas Co., St. Louis, Mo.
EXPERIMENTAL INVESTIGATION OF ULTRAHIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE Annual Report, 1 Jan.-31 Dec. 1968
Jan. 1969 52 p
(Contract NAS7-307)
(NASA-CR-73732; DAC-63119; AR-4) Avail: CFSTI CSCL 07D

Research was undertaken to investigate the effect of metal surface state upon the adhesion between UHV cleaved silicates and metals, the nature and casual mechanisms for the observed charging of UHV cleaved silicates, and the effects of various gases upon adhesion phenomena. Metal surface states considered were sputtered and mechanically abraded surfaces. The surface charging question was approached by measuring charge distributions and magnitude with an electrometer probe, the surface compositional variations with an electron microprobe; and the surface defect profile by etching followed by microscopic observations. The gases utilized for the study of gas effects were N_2, CO_2, O_2, and H_2O. The magnitude of the surface charge was monitored during admission of these gases.
Author

N69-16919# Massachusetts Univ., Amherst. Polymer Research Inst.
LIGHT SCATTERING STUDIES OF ORIENTATION CORRELATIONS IN CHOLESTERYL ESTERS
M. B. Rhodes, R. S. Stein, W. Chu, and R. S. Porter Nov. 1968 44 p refs
(Contract Nonr-3357(01))
(AD-679186; ONR-TR-112) Avail: CFSTI CSCL 7/4

Photographic and photometric light scattering patterns from the cholesteryl esters are analyzed in terms of theories previously developed for the scattering from crystalline polymers. The scattering is shown to primarily result from correlations in orientation of anisotropic elements. The solid state may exist in a negatively birefringent spherulitic form with a size dependent upon crystallization temperature, or may occur in the form of randomly correlated aggregates of crystals best characterized by a correlation function. Such random correlation persists through the smectic state. In the cholesteric state, there is a transition to disc-like non-random correlation with a correlation distance and non-randomness parameters dependent upon the ester, temperature, and thermal history.
Author (TAB)

N69-16936# Office of Naval Intelligence, Washington, D. C. Translation Div.
OPTIMIZED INPUT PARAMETERS FOR THE ELECTROCHEMICAL SYSTEM WITH LIQUID POROUS ELECTRODES OPERATING UNDER THE CONDITIONS OF FORCED FEEDING OF THE REAGENT IN THE CASE OF REVERSIBLE REACTION [K OPTIMIZATSII PARAMETROV VKHODA ELEKTROKHIMICHESKOY SISTEMY S ZHIDKOST-NYMI PORISTYMI ELEKTRODAMI, RABOTAYUSHCHIMI V REZIME PRINUDITEL'NOI PODACHI REAGENTA PRI OBRATIMOY REAKTSII]
I. G. Gurevich et al 3 Sep. 1968 11 p refs Transl. into ENGLISH from Elektrokhimiya (Moscow), v. 4, no. 3, 1968 p 321-328
(AD-679312; NIC-Trans-2681) Avail: CFSTI CSCL 7/4

Three problems are considered for electrochemical devices with liquid porous electrodes, operating under the conditions of forced feeding of the reagent: To optimize the input parameters of the system under a given load on the electrode (I) and coefficient of the consumption of the reagent in order to insure better polarization characteristics; To optimize the input parameters of the system under preassigned coefficients of the consumption of the reagent in order to increase the load on the electrode with more favorable polarization characteristics; To optimize the input parameters of the system at a given load on the electrode in order to increase the coefficient of utilization of reagent with more favorable polarization characteristics.
TAB

N69-16939# Office of Naval Intelligence, Washington, D. C. Translation Div.
CHEMISORPTION AND ELECTRO-OXIDATION OF HYDROCARBONS ON A PLATINUM ELECTRODE [KHEM-OSORBTSIYA I ELEKTROOKISLENIYE UGLEVODORODOV NA PLATINOVOM ELEKTRODE]
A. M. Bograchev et al 3 Sep. 1968 8 p refs Transl. into ENGLISH from Elektrokhimiya (Moscow), v. 4, no. 3, 1968 p 358-361
(AD-679315; NIC-Trans-2682) Avail: CFSTI CSCL 7/4

The effect of the nature of chemisorption of propane on the rate of electro-oxidation was investigated by the potentiodynamic pulse method with 5 mV/sec potential scan.
TAB

N69-16941# Office of Naval Intelligence, Washington, D. C. Translation Div.
CORROSION RESISTANCE OF MATERIAL IN THE AGGRESSIVE MEDIA OF CHEMICAL PROCESSES [KORROSIONNAYA STOYKOST' MATERIALOV (V AGRESSIVNYKH SREDAKH KHIMICHESKIKH PROIZ-VODSTV)]
G. Ya. Vorobeva 1 Oct. 1968 114 p refs Transl. into ENGLISH from Russian
(AD-679328; NIC-Trans-2707) Avail: CFSTI CSCL 11/9

The book is a collection of published data, partially supplemented by experimental data of the author, on the properties and corrosion resistance of the most widely used metallic and nonmetallic structural materials and protective coatings. The book is intended as a reference aid for designers and engineering-technical personnel of chemical plants and scientific research institutes.
TAB

N69-16960 National Lending Library for Science and Technology, Boston Spa (England).
GASEOUS DIELECTRICS
G. Wind 18 Oct. 1968 11 p Transl. into ENGLISH from Rev. Gen. Electron. (France), v. 77, Jan. 1968 p 52–56
(NLL-CE-Trans-4912-(9022.09) Avail: Natl. Lending Library, Boston Spa, Engl.

Report of work carried out at the L.C.I.E. (Central Electricity Industry Laboratory) in 1967. Three aspects of the use of gaseous dielectrics were investigated: (1) the design of a cell to determine gaseous components and assess their degree of pollution by a measurement of dielectric strength; (2) the determination of the permissible heating limits for contacts operating in SF_6 in switchgear; and (3) the thermal behaviour of complex insulations consisting of solid insulators in an SF_6 atmosphere. Author

N69-16996# Army Biological Labs., Fort Detrick, Md.
EUROPEAN CONGRESS ON MOLECULAR SPECTROSCOPICS (FIFTH)
M. M. Sushchinskii Jul. 1968 3 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), v. 31, no. 12, Dec. 1961 p 101–102
(AD-678904; TRANS-1093) Avail: CFSTI CSCL 7/4

This article briefly reviews the papers and topics covered at the Fifth European Congress on Molecular Spectroscopy. TAB

N69-17011# Hull Univ. (England). Dept. of Chemistry.
KINETICS OF HYDROGEN–OXYGEN AND HYDROCARBON–OXYGEN REACTIONS Final Report, Oct. 1966–Oct. 1968 1966–Oct. 1968
Robert R. Baldwin and Raymond W. Walker Oct. 1968 30 p refs
(Grant AF-EOAR-67-01)
(AD-678631; AFOSR-68-2666) Avail: CFSTI CSCL 7/4

This report summarises progress made on three main areas: (1) Further experimental studies of the hydrogen-oxygen and deuterium-oxygen reaction, together with the development of computer programs to interpret the results. (2) Studies of the addition of ethane, propane, n- and isobutane, neopentane, tetraethylsilane and tetramethyl silane to slowly reacting hydrogen-oxygen mixtures. (3) The oxidation of acetaldehyde, propionaldehyde and butyraldehyde in aged boric-acid-coated vessels in the temperature range 400 - 500C. These studies have provided valuable information on the mechanism of the oxidation, and on the reactions of H atoms, OH and HO2 radicals, and alkyl radicals. Author (TAB)

N69-17018# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
SYNTHESES OF IRON AND COBALT COMPLEXES WITH LIGANDS CONTAINING SILICON-NITROGEN BONDS, 1. INTERNAL MOTIONS OF N-ORGANOSILYL KETIMINES, 2
Friedrich Wilhelm Kuepper Aug. 1968 41 p refs
(Contract ARDA SD-88)
(AD-679199; ARPA-TR-35) Avail: CFSTI CSCL 7/2

The report presents results on two research programs, one on inorganic synthesis and one on structural study by means of broad-line NMR, which were pursued simultaneously during the year ending August 31, 1968. The first had to do with the synthesis of compounds of the transition metals containing organosilicon groups. Organosilyl amines were used as electrondonor ligands to form six new stable coordination compounds of iron and cobalt. The second project concerned the structures and behavior of five new compounds prepared last year, all with C=N-Si linkages (plus one additional compound with C=N-C linkage, for comparison). Earlier examination of the UV absorption spectra of these compounds had shown that there is little d pi - p pi interaction between the nitrogen and silicon, because the C=N-Si sequence is not linear but bent at an angle of 120 deg. The spectra were obtained, and calculation of line widths and second moments showed that intramolecular motion in all five organosilicon compounds was hindered more than in the organic compound, and that one of the five (the only one which had an Si-N-C=N-Si structure) had a much more persistent restriction of motion with rise of temperature than the others. Author (TAB)

N69-17036*# National Aeronautics and Space Administration, Washington, D. C.
A CORRECTION ON MY WORK: A NEW DETERMINATION OF MOLECULAR DIMENSIONS [BERICHTIGUNG ZU MEINER ARBEIT: EINE NEUE BESTIMMUNG DER MOLEKUELDIMENSIONEN]
Albert Einstein Jan. 1969 3 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 34, 1911 p 591–592
(NASA-TT-F-12004) Avail: CFSTI CSCL 07D

A correction is presented to Einstein's calculations on the viscosity coefficient of suspensions. A new determination of molecular dimensions is made using the corrected formula. Author

N69-17062# Brown Univ., Providence, R. I. Div. of Engineering.
A QUASICHEMICAL APPROACH TO ADSORPTION AND THE RECOMBINATION OF SURFACE BONDS
Marc H. Richman and Robert D. French (Army Mater. and Mech. Res. Center) Oct. 1968 21 p refs Sponsored in part by Am. Iron and Steel Inst.
(Contract ARPA SD-86)
(AD-678758; ARPA-E60; AISI-200/1) Avail: CFSTI CSCL 7/4

A quasi-chemical model is presented and applied to the adsorption of tungsten on specific crystallographic planes of tungsten. The use of this method requires the assumption of a certain degree of recombination of electron orbitals from surface and subsurface atoms. A set of rules for recombination of bonding is presented and the results calculated using this method are in good agreement both with experimentally determined values of desorption enthalpies and with the tabulated enthalpy of sublimation for tungsten. Author (TAB)

N69-17068# Oak Ridge National Lab., Tenn.
CHEMISTRY DIVISION Annual Progress Report, Period Ending 20 May 1968
G. E. Moore, ed. Sep. 1968 190 p refs
(Contract W-7405-ENG-26)
(ORNL-4306) Avail: CFSTI

Summaries of research projects are presented. The articles are grouped under the following general subjects: (1) nuclear chemistry, (2) isotope chemistry, (3) radiation chemistry, (4) organic chemistry, (5) chemistry of aqueous systems, (6) electrochemical kinetics and its application to control, (7) chemistry and physics of transuranium elements, (8) nonaqueous systems at high temperature, and (9) chemical physics. F.O.S.

N69-17070# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON METASTABLE SPECIES IN ATOMIC AND MOLECULAR BEAMS PRODUCED BY CHARGE TRANSFER, TASKS 1, 2, AND 3 Semiannual Report, 28 Jan.–30 Sep. 1968
J. R. Peterson and G. Black 5 Nov. 1968 28 p refs
(Contract DA-31-124-ARO(D)-446; ARPA Order-553)
(AD-679032; SAR-3) Avail: CFSTI CSCL 7/4

Two types of experiments are being used to study collisions between metastable species and ground state atoms and molecules. One type involves fast beams (energies between 150 and 1000 eV) containing excited particles, and is aimed at developing methods of detecting these species, as well as measuring cross sections for

their collisional deexcitation. Studies of the detection and deexcitation of He 2-1S and 2-3S metastables are reported; the techniques developed for these studies are expected to be used for atmospheric species. The other type of experiment involves the production of metastables by rf excitation and photodissociation of low pressure gases. The mechanisms and rates of energy transfer between many excited and ground state species of particular importance in the upper atmosphere have been examined. Deactivation of O(1D), O(1S), O2(b1 sigma), and N2(A3 sigma) is discussed here. Another phase of our program has involved field measurements of emissions from Ba-Sr releases in the upper atmosphere. Author (TAB)

N69-17076# California Univ., Los Angeles. Dept. of Chemistry.
RECENT STUDIES ON TRIPLET-SINGLET TRANSITIONS IN AROMATIC MOLECULES
M. A. El-Sayed Jul. 1968 39 p refs
(Contract Nonr-4756(07); ARPA Order 306)
(AD-679191 Contrib-2343) Avail: CFSTI CSCL 7/5

The paper is divided into four parts. The first part discusses the selection rules of the intersystem crossing process in systems having both n, pi(*) and pi,pi(*) types of states. The detection of the polarized state by observing the phosphorescence emission requires that the radiative lifetime of the latter from at least one of the three sublevels of the lowest triplet state be shorter than the characteristic time for the spin-lattice relaxation processes between the three sublevels of the triplet state. This is demonstrated to be the case for pyrazine in its n,pi(*) triplet state at low temperatures (1.6 -10K) and discussed in Section III. In the third part of the paper, a summary of the theory of the triplet-singlet radiative transitions is given. A comparison of phosphorescence properties of the different systems is made and the observed differences are explained in the framework of the present theory. In the last part of this paper, the important experiments needed in this field are recommended. Author (TAB)

N69-17077# California Univ., Los Angeles. Dept. of Chemistry.
SPIN POLARIZATION AND SPIN-LATTICE RELAXATION IN THE LOWEST TRIPLET STATE OF PYRAZINE AT 1.6 °K
M. A. El-Sayed, L. Hall (Ph.D. Thesis), A. Armstrong, and W. R. Moomaw Feb. 1968 19 p refs Submitted for publication
(Contract Nonr-4756(07); ARPA Order 306)
(AD-679192; Contrib-2091) Avail: CFSTI CSCL 7/5

The different mechanisms proposed for the spin-lattice relaxation process of a paramagnetic impurity in ionic crystals are briefly summarized. The decay characteristics of the pyrazine phosphorescence in cyclohexane and benzene matrices at 1.6K and its temperature dependence can best be explained if competition between the spin-lattice relaxation process between the triplet sublevels and the radiative process from one of the sublevels of pyrazine is invoked. A scheme is found to explain the observed temperature effects on the decay characteristics as well as the unique phosphorescence polarization along the N...N axis of the pyrazine molecule. The effect of the magnetic field on the decay curve is demonstrated, and briefly described. Author (TAB)

N69-17101*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
FORMATION OF NITROGEN CONTAINING HETEROCYCLIC COMPOUNDS AFTER X-RAY EXPOSURE OF AQUEOUS SOLUTIONS OF ALIPHATIC AMINES AND AMINO ACIDS [ZUR BILDUNG VON STICKSTOFFHALTIGEN HETEROZYKLEN NACH ROENTGENBESTRAHLUNG VON WAESSRIGEN LOESUNGEN ALIPHATISCHER AMINE UND AMINOSAEUREN]
E. Hussman Washington NASA Jan. 1969 9 p refs Transl. into ENGLISH from the German Rept. BMWF-FB-W-68-30
(Contract NASw-1692)
(NASA-TT-F-12091; BMWF-FB-W-68-30) Avail: CFSTI CSCL 07E

A post-radiation mechanism is described which leads to the formation of heterocyclic compounds. This aftereffect was observed in the irradiation of aqueous aliphatic amine or amino acid solutions when UV spectrophotometric examinations disclosed that the extinction of the solution changed long after the irradiation had ended. However, the extinction changes only if the structure of a part of the molecules changes due to one or more chemical reactions. The experiments were conducted with a lysine solution in the presence of oxygen. The role of this aftereffect in the formation of ketones and ketone acids was studied. Fluorescence-spectrophotometric studies were performed to verify the results. Author

N69-17119# Mason and Hanger-Silas Mason Co., Inc., Burlington, Iowa. Development Dept.
A RAPID GAS-LIQUID CHROMATOGRAPHY METHOD FOR THE QUANTITATIVE ANALYSIS OF 1,1,2 TRICHLORO 1,2,2 TRIFLUORO ETHANE (FREON 113) IN AIR Technical Report, 1966–1968
Ted W. Stull 10 Oct. 1968 12 p refs
(Contract DAAA09-68-C-0468)
(AD-679035; TR-163) Avail: CFSTI CSCL 7/4

Described herein is a rapid method for the quantitative analysis of 1,1,2 Trichloro 1,2,2 Trifluoro Ethane (Freon 113) in atmospheric concentrations ranging from one (1) to one thousand (1,000) parts per million. This gas-liquid chromatographic method utilizes the flame ionization detector and employs a unique method of standardization. The standard can be prepared, a complete concentration range chromatographed and graphed in approximately fifteen minutes. This procedure is not limited to the concentrations quoted here. Both lower and higher concentrations are easily analyzed by mere adjustment of the prepared standard, instrument adjustments, or sample size injected. The method outlined here has been in use for approximately two years and has proven both reliable and accurate. Its advantage lies in the ease, simplicity and rapidity of both standardization and subsequent analysis. Author (TAB)

N69-17127# National Academy of Sciences National Research Council, Washington, D. C. Committee on Nuclear Science.
RADIOCHEMISTRY OF SILICON
David R. Schink (Isotopes, Inc., Palo Alto, Calif.) Oak Ridge, Tenn. AEC Nov. 1968 74 p refs Revised
(NAS-NS-3048-Rev) Avail: CFSTI

Topics covered include: nuclear properties and production of silicon isotopes, chemistry of silicon compounds, separation techniques, dissolution of samples containing silicon, analytical methods for silicon compounds, safety practices, and radiochemical practices and counting techniques for ^{31}Si and ^{32}Si. NSA

N69-17133# Argonne National Lab., Ill.
SEVEN-VALENT STATE OF TRANSURANIUM ELEMENTS. PREPARATION AND IDENTIFICATION OF Np (7) IN AQUEOUS SOLUTIONS AND IN THE SOLID STATE [SEMIVALENTNOE SOSTOYANIE TRANSURANOVYKH ELEMENTOV. POLUCHENIE I IDENTIFIKATSIYA NEPTUNIYA (7) V VODNYKH RASTVORAKH I TVERDOM VIDE]
N. N. Krot et al Oct. 1968 10 p refs Transl. into ENGLISH from Radiokhimiya (USSR) v. 10, no. 4, 1968 p 412-418
Sponsored by AEC
(ANL-TRANS-678) Avail: CFSTI

It was established that during the passage of ozone through a suspension of Np in alkali, bright green solutions of Np(VII) were obtained. The heptavalent state of Np in ozonized alkaline solutions was confirmed by different methods. A compound of Np(VII) with the composition $Co(NH_3)_6 \cdot NpO_5 \cdot 3H_2O$ was separated in the solid state and analyzed. Author (NSA)

N69-17153# European Co. for the Chemical Processing of Irradiated Fuels, Mol (Belgium).
DETERMINATION OF FLUORINE IN NUCLEAR FUEL REPROCESSING SOLUTIONS USING A FLUORIDE-SENSITIVE ELECTRODE
H. H. Ph. Moeken, H. Eschrich, G. Willeborts May 1968 19 p refs
(NP-17617; ETR-190) Avail: Issuing Activity

Procedures for determining the fluorine concentration in zirconium decladding (Zirflex) solutions, uranium feed solutions, and uranium final product solutions are described. The determinations are based on potential measurements of a fluoride-sensitive electrode versus a saturated calomel electrode after a relatively simple pretreatment of the sample as dilution, complexing of metal constituents or separation by a cation exchange column. Author (NSA)

N69-17156# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
KINEMATICS OF ION-MOLECULE REACTIONS
A. Henglein Oct. 1968 63 p refs Presented at the Intern. School of Phys. "Enrico Fermi"—44th Course Molecular Beams and Reaction Kinetics, 29 Jul.–10 Aug., 1968
(HMI-B-77) Avail: CFSTI

The details of the reaction mechanism for ion-molecule reactions are covered. The polarization theory is presented and its limitations and agreement with experimental data are shown. Several types of direct reaction theories and the energy ranges at which they are applicable are discussed and compared with the experimental results. Finally, examples are presented of reactions which show a change from a direct to a complex mechanism as the relative energy is decreased. NSA

N69-17157# Los Alamos Scientific Lab., N. Mex.
SOME INDIVIDUAL ION CORRELATIONS AMONG AQUEOUS FREEZING POINT MEASUREMENTS
Guy R. B. Elliott 29 Oct. 1968 40 p refs
(Contract W-7405-ENG-36)
(LA-3891) Avail: CFSTI

The experimental basis for thermodynamic solution theory is discussed, and a revised application of Debye–Huckel theory to the solvent behavior is examined. Over much of the concentration range of freezing point measurements for 1–1 electrolytes (up to approximately 1.2 molal, but excluding the most dilute solutions), the freezing point depressions, θ, can be described by equations of the form $\theta = \theta^{st} + k_1^* m + b_1^* m^2$, where θ^{st} is derived from Raoult's law plus Debye–Huckel interactions, m is molality, and k_1^* and b_1^* are constants. The experimental values of k_1^* and b_1^* for 1–1 salts of strong acids can be correlated through empirical individual ion parameters, which can be added to give approximate values of k_1^* and b_1^*. With few exceptions, the calculated and experimental values agree well. The 2–2 electrolytes appear to obey the same equation form in dilute solutions but to show changes in the constants at about 0.05 molal. Alcohol solutes also lead to a similar behavior except that θ^{st} is replaced by a simple Raoult's law term. Author (NSA)

N69-17172# Japan Atomic Energy Research Inst., Tokyo.
PRODUCTS OF γ-RAY INDUCED TELOMERIZATION REACTION BETWEEN ALLYL ALCOHOL AND CARBON TETRACHLORIDE
Masao Okubo (Gov. Ind. Res. Inst., Nagoya, Japan) Aug. 1968 12 p refs Transl. from Nippon Kagaku Zasshi (Tokyo), v. 88, no. 2, Feb. 1967 p 212–215
(NSJ-TR-127) Avail: CFSTI

The 1:1-telomer, 2, 4, 4, 4-tetrachlorobutanol, produced by γ-induced telomerization reaction between allyl alcohol and carbon tetrachloride, was isolated without decomposition by distillation under reduced pressure. But, the 2:1-telomer was very unstable and dehydrochlorinated easily. The dehydrochlorinated product was shown to be 4 (β, β, β-trichloroethyl) tetrahydrofurfuryl alcohol. This compound was also obtained in high yields by treating telomers of allyl carboxylates in methanol with hydrochloric acid and/or with potassium hydroxide. This method was used to determine the production ratio of 2:1-telomers to 1:1-telomers of higher boiling allyl carboxylates. The results obtained showed that allyl carboxylates with bulkier carboxyl residues had lower values of telomer production ratios. From relations between production ratios and velocities of double bond consumption, the reaction mechanism was discussed. Author (NSA)

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N69-18109*# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering.
A SPACE COMMUNICATION STUDY Final Report, 15 Sep. 1967–15 Sep. 1968
Donald L. Schilling, Kenneth K. Clarke, and Raymond L. Pickholtz 15 Sep. 1968 182 p refs
(Grant NGR-33-006-020)
(NASA-CR-99236; PIB-EE-68-0012) Avail: CFSTI CSCL 17B

A research summary is presented on the problem of transmitting and receiving analog and digital signals through noisy media. The results of the threshold extension studies are used to determine the output signal to noise ratio (SNR) of an FM demodulator when the input SNR of a frequency modulated signal is known. In addition, the probability error obtained under frequency shift keying transmission can also be determined. Two different techniques are used to determine the output clicks, and hence the threshold performance and error rate of the phase locked loop (PLL). Both techniques assumed that the noise present at the PLL output can be represented by a smooth component, which is almost gaussian, and an impulse or click component. The transmission of TV signals through a noisy, fading channel are considered. FM transmission is used and the received picture is obtained using a frequency locked loop and a FM discriminator demodulator. Single sideband frequency modulation and the characteristics of FM were also studied. Synchronism procedures for single channel phase shift keying communication systems were considered. The recursive methods previously developed were implemented in practice by using estimates of the signal derivatives. Author

N69-18158# Mitre Corp., Bedford, Mass.
NARROWBAND INTERFEROMETER IMAGING

N. M. Tomljanovich, H. S. Ostrowsky, and J. F. A. Ormsby Nov. 1968 27 p
(Contract AF 19(628)-5165)
(AD-679208; WP-1985; ESD-TR-68-274) Avail: CFSTI CSCL 17/9

The use of narrowband interferometry at small bistatic angles to obtain two and three dimensional images as scattering center plots is demonstrated. Considerations on resolution and ambiguity for range and cross range are covered for both ideal and actual conditions. The methods utilize Fourier transform phase from Doppler resolved scattering center returns at each site. Author (TAB)

N69-16159# Mitre Corp., Bedford, Mass.
RESULTS OF CATEGORY 2 TESTING OF PHILCO-FORD MODEMS AT CAPE KENNEDY AFS
R. W. Gilliatt and R. M. Steeves Nov. 1968 29 p
(Contract AF 19(628)-5165)
(AD-679207; MTR-749; ESD-TR-68-380) Avail: CFSTI CSCL 17/2

This document describes the results of field testing of wireline modem, evaluation tests of a radio modem and the establishment of the phase jitter characteristics of submarine cable data transmission system after modification. Author (TAB)

N69-16162*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ERROR ANALYSIS OF INPUT-NOISE-TEMPERATURE MEASUREMENTS OF LOW-NOISE AMPLIFIERS
Hans-Juergen C. Blume Washington Jan. 1969 41 p refs
(NASA-TN-D-4997) Avail: CFSTI CSCL 09C

The method presented provides means of determining all effects which significantly influence measurement of the output-noise-power ratio (Y-factor) of a typical low-noise-amplifier test setup. The error analysis of the Y-factor method illustrates the error propagation which occurs in the derivations of the input noise temperature and gives an estimate of the maximum error. The general concepts used in determining these influences and the error propagation are applied to reflection-type amplifiers. Numerical examples demonstrate the value in considering all elements which (1) affect the calibrated noise power along the transfer path from the noise source to the amplifier under test, and (2) add noise power along the path from the amplifier to the noise indicator. The error analysis applied to the examples revealed that for minimization of the input-noise-temperature error, accurate knowledge of the losses and temperatures is more important than obtaining extremely high ratios of the hot- to cold-noise source temperatures. A comparison between the input noise temperature determined by considering all influencing effects and the input noise temperature determined without considering these effects for a typical low-noise measuring system for reflection-type amplifiers revealed a considerable difference. Author

N69-16196*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPARSION OF SEQUENTIAL DECODING METRICS BY COMPUTER SIMULATION
Thomas V. Saliga (M.S. Thesis—Md. Univ., College Park, 1968) Washington Jan. 1969 56 p refs
(NASA-TR-R-294) Avail: CFSTI CSCL 17B

This paper determines a sequential decoder's performance and metric sensitivity by means of a computer simulation using two metrics: (1) A log-a-posteriori probability metric, and (2) A cross-correlation metric. Both metrics are defined, derived, and tabulated for the memoryless gaussian channel. Simulations of a rate 1/2, constraint-length 32 coded data system are made using 16 level quantized metrics. When good metric and decoder parameters have been found, the decoder's computational load, overflow probabilities, and error probability are found as a function of channel signal-to-noise ratio, using at least 500 simulated telemetry frames per data point. It is shown that the correlation metric is inferior to the probability metric by at least 1.5 decibels and suffers a higher error rate. In addition, the correlation metric decoder degrades intolerably with 0.5 decibel signal-amplitude fluctuations, whereas the probability metric decoder is negligibly affected. Author

N69-16234# Army Electronics Command, Fort Monmouth, N. J.
SPEED BUFFERING AND DIGITAL COMBINING TECHNIQUES
M. B. Pickover Sep. 1968 17 p refs
(AD-678495; ECOM-3021) Avail: CFSTI CSCL 9/5

The feasibility of Asynchronous Digital Combining has been proven by theoretical analysis and the fabrication of two Asynchronous Digital Combiners (ADC) demonstrating the combining of the output of four production PCM 12-Channel Multiplexers into one digital output stream. A typical application of the ADC is documented and future plans are discussed. Author (TAB)

N69-16271 Colorado Univ., Boulder.
ANALYSIS AND SYNTHESIS OF MONOPULSE PHASED ARRAYS
Chour-Chi Pang (Ph.D. Thesis) 1967 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-10637

It is the objective of this dissertation to give a timely mathematical formulation for monopulse phased arrays by defining the sum gain of the system, as well as the peak difference gain and the slope of the difference pattern. The text of this dissertation is divided into two parts, the analysis and the synthesis. In the first part, the effects of various array parameters on both sum and difference gains are analyzed. Arrays of constant and nonuniform spacings have received equal attention. Important conclusions are then drawn from this analysis. While in the second part, it is found that both sum and difference gains can be expressed as the ratio of two quadratic forms (or the so called Raleigh's quotient). Hence, the well known method for eigenvalue problems is employed to synthesize an optimum monopulse array with certain prescribed criteria. Dissert. Abstr.

N69-16289# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIRECTIVE GAIN OF CONVEX PENCIL-BEAM ANTENNAS
D. I. Voskresenskiy et al 3 Jan. 1968 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radioelektron. (USSR), v. 10, no. 2, 1967 p 103-112
(AD-678625; FTD-HT-23-1194-67) Avail: CFSTI CSCL 9/5

A study is made of the problem of directive gain of convex pencil-beam antennas with given magnetic currents on an ideally conducting surface of arbitrary shape whose characteristic dimensions and curvature radii significantly exceed the wavelength. A solution to the problem is obtained by an approximation method, taking into account the shielding effect of the conducting surface. The authors determine the optimum distribution of magnetic currents on ideally conducting spheres and cones, and the directive gain of such bodies. TAB

N69-16312 Princeton Univ., N. J.
ON THE CHARACTERIZATION OF RANDOM PROCESSES
Ian Fraser Blake (Ph.D. Thesis) 1967 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-8907

Useful alternatives are provided to the assumption of normality in the analysis of systems subject to a random signal. Some of the problems encountered in the definition of a random process are discussed and several examples are given. It is shown that the properties of linear conditional expectations and closure under linear operations uniquely define the class of spherically invariant processes, which is larger than and contains the class of normal processes. These processes are analyzed extensively. Their n-variate characteristic and probability density functions are found to be simply related by a Hankel Transform. The precise relationship between spherical invariance and normality are investigated and conditions for the ergodicity of spherically invariant processes are given. The class of linear processes is considered and some aspects of spectral theory which play an important role in determining the properties of these processes are summarized. Dissert. Abstr.

N69-16397 Illinois Univ., Urbana.
GUIDING PROPERTIES OF A PERIODIC ARRAY OF SLOTS
Gary Sandy Brown 1967 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-8032

Two dimensional modal fields on a structure consisting of an infinite periodic series of slotted metal planes are studied. Integral equations involving the unknown field in one slot or iris and the propagation constant are formulated for both types of field polarization with the aid of appropriate Green's functions and reduced to infinite matrix equations via the application of Galerkin's method in the Fourier transform domain. The elements of the matrices in the determinantal equation involve integrals of the odd and even radial Mathieu functions of the first kind, but may be evaluated by applying the method of saddle points. For a given polarization, the first two modal propagation constants and slot field distributions are computed for both even and odd field symmetry. The real or attenuating part of the propagation constant is found to oscillate between a maximum and minimum value as a function of the distance between adjacent planes when this distance is large compared to the slot width. The field distribution in the iris is also found to be very insensitive to plane spacing but becomes more peaked as the iris width is increased. Dissert. Abstr.

N69-16405 National Lending Library for Science and Technology, Boston Spa (England).
SIGNAL DISTORTION RESULTING FROM IRREGULARITIES IN H_{01} WAVEGUIDES
H. L. Hartmann 19 Nov. 1968 22 p refs Transl. into ENGLISH from Arch. Elek. Uebertrag. (Germany), v. 21, no. 7, Jul. 1967 p 345-354
(NLL-PORS-Trans-2509-(9022.81) Avail: Natl. Lending Library, Boston Spa, Engl.

The irregularities of technically produced long haul H_{01} waveguide give rise to stochastic fluctuations of the propogation constant whose mean-root-square is calculated. In so doing arbitrary autocorrelation functions of the waveguide irregularities with limited correlation range are assumed. The typical frequency and length dependence of the H_{01} attenuation and phase fluctuations are devised. From these fluctuations the relative distortion power (reconversion noise power) is calculated which results, for instance, in the transmission of pulse code modulated signals (data) at the receiving end of the inhomogeneous cable. The relations stated are used for rating an 0.7 km experimental line of dielectrically loaded waveguide in the frequency range of 30 to 40 GHz. Author

N69-16475 *\#* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT: SPACE PROGRAMS SUMMARY, VOLUME 3
31 Oct. 1968 264 p refs
(Contract NAS7-100)
(NASA-CR-99217; JPL-SPS-37-53-Vol-3) Avail: CFSTI CSCL 22

Summary information is presented on the supporting research and advanced development projects pertaining to systems analysis and engineering, guidance and control, propulsion, space sciences, and telecommunication. For individual titles, see N69-16475 through N69-16497.

N69-16489 *\#* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS ELEMENTS RESEARCH
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 161-168 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 17B

Design details are presented on two new models of the 400 MHz coaxial cavity radiator antenna. These modifications to the orginal antenna consist of (1) a flared aperture model, intended to demonstrate that the power-handling capability of a coaxial cavity radiator can be improved by reducing the high field at and near the cavity by flaring the aperture; and (2) a wide cavity model intended to demonstrate that widening the cavity can improve the power-handling capability. Test results show that improved power-handling capabilities were achieved by both models. Summary test data are presented on the compressive strength characteristics of a foam for the sterilizable high-impact, square-cup radiator. Mechanical beam steering performance in a model erectable antenna is discussed briefly. M.G.J.

N69-16491 *\#* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH: SEQUENTIAL DECODING
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 171-175 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 17B

A sequential decoder was to be available for experimentation on a portion of the Pioneer D mission; convolutional coding with sequential decoding was planned as an engineering experiment. Equations are derived to determine decoder error probability, noisy phase reference, and system performance in the presence of a noisy phase reference. The data are assessed and interpreted, and it is concluded that a comparison with results for uncoded PSK systems indicates that, even at rates on the order of 16 bits/s, the sequential decoding system offers about a 2 dB advantage. M.G.J.

N69-16492 *\#* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH: CODING AND SYNCHRONIZATION STUDIES
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 176-191 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 17B

Error performance capabilities are presented on an orthogonal signal frequency-shift-keyed ground-to-spacecraft command link, which codes low rate binary information into one of two frequency modulated tones modulated onto the carrier. It is assumed that the phase error out of the spacecraft tracking loop does not vary significantly over a bit time, and that the phase error out of the spacecraft tracking loop does vary significantly over a bit time. A straightforward mathematical analysis of a serial orthogonal decoder is conducted. Previously obtained data on the asymptotic performance of the optimal codes for the additive white gaussian channel are extended by shown the essential equivalence of all memoryless input-discrete very noisy channels to the white gaussian channel and thus extending the strong converse to this wider class of channels. M.G.J.

N69-16494 *\#* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH: PROPAGATION STUDIES

In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 194-199 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 09F

The basic problem of identifying linear systems from noisy input-output measurements is considered. Two sequential identification procedures are presented for identifying a time invariant, linear system in which no knowledge of the dynamics of the system were known prior to the identification, with the exception that the memory of the system was required to be finite. The first algorithm required only a mild condition on the covariance function of the input random process and no knowledge of the input or output measurement noise statistics other than that they have finite variances. It was shown that the estimate of the system converged in mean square; however, a bias developed that was due to the input noise and consequently prevented the estimate from being consistent. The second algorithm was derived based on the additional assumption that the input measurement noise variance was known. It was shown that the estimate of the unknown system converged in mean square to the unknown system. Hence, if the input noise variance is known, this algorithm can be used to obtain a consistent estimate of the unknown system. Author

N69-16495*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH: COMMUNICATIONS SYSTEMS DEVELOPMENT
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 200-214 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 09D

To estimate the phase of a square wave in white noise, a determination is made of the functional form of the optimum (maximum likelihood) processing of the outputs of the two correlators and the accuracy of the resulting estimate. A general two-correlator estimation scheme is considered from the viewpoint of maximizing the average signal-to-noise ratio (SNR) during acquisition. It is found that the best two correlators for this purpose are the sine and cosine waves, even though the received signal is not sinusoidal. The sum of the SNRs is then phase-independent and is only 1.0 dB below the theoretical maximum when the received signal is a square wave. Moreover, the processing of the above correlator outputs to give the maximum likelihood phase estimate is also independent of the structure of the ranging signal, being of the same form for all signals that it is for the sine wave phase estimator. Using a widely accepted model of the soft limiter, it is shown that the output signal power and signal suppression can be found exactly in terms of the hard limiter signal-suppression function. The output noise is correspondingly well approximated. M.G.J.

N69-16496*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH: INFORMATION PROCESSING
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 215-227 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 09D

Established results concerning the output of a digital filter when the input is a random sequence are reported. Consideration is given to the symbol synchronization problem for binary systems in which the subcarrier frequency and the symbol rate are coherent; i.e., they are derived from the same frequency reference. The basic problem involves finding the optimum decision rule for estimating the correct symbol timing based on observations of the received noisy data for a fixed length of time. Two methods that approximate the maximum likelihood rule are examined: one at high signal-to-noise ratios (SNR), and one at low SNR. Numerical results for these approximations are presented. M.G.J.

N69-16497*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH: DATA COMPRESSION TECHNIQUES
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 228-241 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 09D

An equation is given for the density function, $g(\chi)$, of a mixture of two normal distributions with proportions p and 1 - p. The problem of constructing estimators for p is discussed, and a more efficient method than previously proposed is suggested. In particular, when $\mu_1 \quad \mu_2$, one estimator is given based on a single quantile and another based on a linear combination of six quantiles. It is also shown that, in some cases, combining the two estimators gives the best results. For the special case $\mu_1 = \mu_2$, estimators using two symmetric quantiles give results comparable to that achieved using the four quantile estimators. Theorems are presented to show that the epsilon entropy of any mean-continuous gaussian process on L_2 [0,1] is finite for all positive ϵ. The epsilon entropy of such a process is defined as the infimum of the entropies of all partitions of L_2 [0,1] by measurable sets of diameter at most ϵ, where the probability measure on L_2 is the one induced by the process. Fairly tight upper and lower bounds are found for the epsilon entropy $\epsilon \to 0$ in terms of the eigenvalues of the process. M.G.J.

N69-16513 Michigan Univ., Ann Arbor.
SIGNAL EXTRACTION OF SYMMETRIC FUNCTIONS FROM NOISE
Richard Stephen Norman (Ph.D. Thesis) 1967 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-7684

The extraction of signals from noise is possible if some prior knowledge is available concerning the signal or the noise. In this work, the prior knowledge is expressed in terms of symmetry relations on the data space, the domain of the data. It is assumed that the data is the sum of a symmetric signal function and a sample function from a noise process. The noise process is assumed to be independent of the signal and to have zero mean and known covariance. The problem is to find an optical data processing operator which produces a signal estimate with the smallest mean square discrepancy from true signal function. The concept of symmetric functions is sufficiently broad, to include more than just photographs of symmetric structures. It also includes statistical sampling, multivariate or replicated data, and periodic functions. Dissert. Abstr.

N69-16726# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astro Physics Lab.
PHASE QUADRATURE COMPONENTS OF THE MICROWAVE SCATTERED FIELD IN A SHORT TROPOSPHERIC PATH AS RELATED TO THE METEOROLOGICAL PARAMETERS
C. I. Beard, W. T. Kreiss, and W. G. Tank Sep. 1968 25 p refs Presented at 14th Symp. "Scatter Propagation of Radio Waves" Sandefjord, Norway, 19-23 Aug. 1968; Sponsored by NATO-AGARD Submitted for publication
(AD-679358; D1-82-0756) Avail: CFSTI CSCL 20/14

A microwave propagation experiment was established on a line-of-sight path equipped with extensive meteorological instrumentation to show quantitatively the effect of the atmospheric scatterers on the microwave statistics. A particular microwave technique is used at 10.4 GHz which resolves the received microwave field into its phase quadrature components to provide the statistics of the incoherent scattered field directly, since these are the quantities sensitive to the atmospheric fluctuations. The effect of the sphericity of the wavefronts over the scatterers provides an additional descriptive parameter. The usefulness of the technique in scattering work is to pin down the statistical model of the scattered field, e.g., over a 3.57 km path it shows that the incoherent scattered field lies almost entirely at a phase angle of plus or minus 90 degrees to the coherent field and is also normally distributed. The meteorological instrumentation is unique in that integrated

measurements are made of the defining refractivity parameters; i.e., (1) an infrared transmissometer operating in absorption bands of oxygen and water vapor at 1.27 and 1.18 microns, respectively, measures integrated dry air and water vapor partial densities, and (2) a microwave transmissometer operating in the 22.2 GHz water vapor band measures the integrated water vapor density-to-temperature ratio. Such integrated data admit to direct comparison with the 10.4 GHz near field scattering effects. More conventional meteorological instrumentation is also utilized. Author (TAB)

N69-16740*# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
A STUDY OF AN ASYMMETRIC CASEGRAINIAN-ANTENNA FEED SYSTEM AND ITS APPLICATIONS TO MILLIMETER-WAVE RADIO-ASTRONOMICAL OBSERVATIONS
S. D. Slobin Dec. 1968 190 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952210)
(NASA-CR-73810; USCEE-321) Avail: CFSTI CSCL 09F

The design, analysis, and evaluation of a nodding hyperboloidal subreflector in a Cassegrainian antenna system used for radio astronomical investigations are discussed. A theoretical analysis of spherical electromagnetic wave scattering from a tilted hyperboloid is carried out using methods of vector diffraction theory. Theoretical expressions for the amplitude and phase of the resultant fields are given; but these expressions are of such complexity that digital computer solution using numerical integration techniques is necessary. A complete description of the nodding subdish system is given, including the RF and electronic system used in processing received signals. A discussion of the mechanical and electronic considerations associated with this particular nodding subdish system is made; and a discussion of low frequency switching problems in general is carried out, based upon a series of radiometer noise and gain change measurements made as a function of subdish switching frequency. A unique method of signal calibration is discussed, with primary emphasis on radio astronomical applications. Author

N69-16745 Rochester Univ., N. Y.
RADAR SIGNAL DESIGN USING THE AMBIGUITY FUNCTION
John Stewart Thompson (Ph.D. Thesis) 1968 166 p
Avail: Univ. Microfilms; HC $7.80/Microfilm $3.00 Order No. 68-9399

A simple model of a radar system, which includes only target range and range-rate as significant parameters, is reviewed. This model assumed a matched filter receiver. The output of this filter is designated the time/frequency autocorrelation function. The squared magnitude of this function, which is assumed to be the output after detection, is designated the ambiguity function. The ambiguity function is established as a criterion for radar signal design relative to the assumptions of the system model presented. Existing results for the time/frequency autocorrelation function are reviewed in order to emphasize the difficulty of establishing similar results for the ambiguity function. A general procedure for the approximation of ambiguity functions is developed which leads to necessary and sufficient conditions on the function. Dissert. Abstr.

N69-16779# Harry Diamond Labs., Washington, D. C.
RADIATION PATTERNS OF A SQUARED APERTURE PARABOLIC REFLECTOR
Harry K. Morlock Sep. 1968 21 p
(AD-679017; HDL-TM-68-24) Avail: CFSTI CSCL 9/5

The calculated radiation patterns of an illuminated square aperture parabolic reflector are compared with those of a circular aperture parabolic reflector having the same focal length and a diameter equal to the square side length. The circular apertures focal length-to-diameter ratio is one, and its diameter-to-operating wavelength ratio is 60. The E vectors orientation in the linear aperture illumination wave is varied from parallel to the aperture diagonal to parallel to the sides of the square reflector. The main advantage of the square aperture reflector is the increased side lobe suppression in the E-H plane when the feed horn is in the latter orientation. Author (TAB)

N69-16782# Northeastern Univ., Boston, Mass.
UHF TELEMETRY SYSTEM TEST FLIGHT
Lawrence J. O'Connor Aug. 1968 33 p refs
(Contract AF 19(628)-5140)
(AD-678881; AFCRL-68-0445; SCIENTIFIC-3) Avail: CFSTI CSCL 9/6

This report presents a UHF Telemeter System that was flown on Air Force Cambridge Research Laboratories Aerobee rocket AF3.268 on 13 December 1967 at the White Sands Missile Range, New Mexico. The purpose of the test was to assist in the preparation for a smooth transition to the UHF telemeter bands by 1 January 1970. A discussion of the instrumentation includes two PAM/FM/FM telemetry systems, one at VHF and the other at UHF. Data from the test flight is presented for comparison. This includes AGC records and demodulated waveforms. Author (TAB)

N69-16785*# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group.
BROADBAND MULTIMODE HORNS Final Report, 27 Jun.–10 Dec. 1968
10 Dec. 1968 223 p Prepared for JPL
(Contracts NAS7-100; JPL-952326)
(NASA-CR-73638) Avail: CFSTI CSCL 09F

This report describes a design study of a new multimode technique which permits broadband operation of low noise high efficiency antenna feeds. This technique utilizes a multimode section wherein the principal waveguide mode excites a TEM mode (in addition to the principal mode) in the mode control section. At the end of the mode control section the TEM mode is converted into the TM°_{11} mode, which combined with the TE°_{11} mode provides primary pattern shaping. The use of the TEM mode, which determines, in part, the phase of the TM°_{11} mode at the horn aperture, is the key to the broadband operation because it has a slower phase velocity than the fundamental TE°_{11} mode, which in turn has a slower phase velocity than the TM°_{11} mode. That is, the phase of the TM°_{11} mode at the horn aperture relative to that of the fundamental TE°_{11} mode is determined by the "average" phase velocities of the TEM° and TM°_{11} modes which can be made nearly equal to the average phase velocity of the fundamental TE°_{11} mode over a broad frequency band. Author

N69-16798# RAND Corp., Santa Monica, Calif.
EXACT SOLUTION FOR THE PROPAGATION OF ELECTROMAGNETIC PULSES OVER A HIGHLY CONDUCTING SPHERICAL EARTH
W. Sollfrey Oct. 1968 58 p refs
(Contract F44620-67-C-0045)
(AD-678869; RM-5792-PR) Avail: CFSTI CSCL 20/14

The report presents an analytic solution for the propagation of electromagnetic pulses by ground waves, a problem previously treated by the saddle-point method or numerical integration. In this study, the various integrals are evaluated exactly. First the problem is formulated and the limitations of the saddle-point method are discussed. Then the required integrals are evaluated exactly as products of airy functions. Detailed results are worked out for a step and ramp source; the technique is also applied to a waveform of nuclear origin that had previously been investigated by numerical integration. The step and ramp function responses are shown to be well approximated by a single mode for early and intermediate times. The saddle-point approximation is valid only for

times before the peak, but is a good approximation out to 50 times that duration. At late times, the single-mode exact response goes through zero, reaches a broad negative maximum, and then returns slowly to zero, while the saddle-point single mode and the mode sum responses remain positive; the ramp function displays corresponding behavior. For the nuclear waveform, the exact curves have the same general character and about the same peak values as the numerical integration results, but the exact curves consistently display a faster time scale, and the spectrum peaks at a higher frequency. Author (TAB)

N69-16875# Resources Development Inst., Greenlawn, N. Y.
MILLIMETER/MICROWAVE RADOMES—SUSCEPTANCE THEORY FOR A METALLIC CIRCULAR HOLE LATTICE Technical Report, 7 Apr. 1967–31 Oct. 1968
Edward B. McMillan Oct. 1968 78 p refs
(Contract N00014-67-C-0433)
(AD-678950; Rept-831101) Avail: CFSTI CSCL 17/9

As an aid to more advanced electronics and aerospace vehicles, research was directed toward obtaining parameters capable of providing greater electrical and mechanical radome design latitude. The millimeter/microwave region was considered, measurements being conducted in the former. The work comprised building up theory on the susceptance of lattices of circular inductive holes. Author (TAB)

N69-16928# Joint Publications Research Service, Washington, D. C.
SIGNAL SEARCHING AND GROUND REFLECTION
18 Dec. 1968 49 p Transl. into ENGLISH from Russian Books
(JPRS-47108) Avail: CFSTI

CONTENTS:

1. SIGNAL SEARCHING BY THE FREQUENCY METHOD G. I. Tuzov p 1–24 (See N69-16929 06-07)
2. SOME PROBLEMS OF PRACTICAL APPLICATION OF STATISTICAL CHARACTERISTICS OF SIGNALS REFLECTED FROM THE GROUND S. G. Zubkovich p 25–46 (See N69-16930 06-07)

N69-16929# Joint Publications Research Service, Washington, D. C.
SIGNAL SEARCHING BY THE FREQUENCY METHOD
G. I. Tuzov *In its* Signal Searching and Ground Reflection 18 Dec. 1968 p 1–24 Transl. into ENGLISH from the book "Vydeleniye i Obrobotka Informatsii v Dopplerovskikh Sistemach" USSR, 1967 p 223–243 (See N69-16928 06-07)
Avail: CFSTI

The use of narrow band tracking filters in Doppler devices requires a special system designed for signal searching by the frequency method and for initial adjustment of the tracking filters. An analysis is presented of correlation and spectral searching methods and the probability coefficients at various frequencies for signal detection by the optimum system using these methods. The construction of an optimum filter based on the principles of sequential and parallel analysis is also discussed. From the analyses, it is concluded that if an optimum filter based on the principle of sequential analysis is used in a tracking regime, it must be a tracking filter. The use of this tracking filter in a signal searching system is then described and evaluated. A.C.R.

N69-16930# Joint Publications Research Service, Washington, D. C.
SOME PROBLEMS OF PRACTICAL APPLICATION OF STATISTICAL CHARACTERISTICS OF SIGNALS REFLECTED FROM THE GROUND
S. G. Zubkovich *In its* Signal Searching and Ground Reflection 18 Dec. 1968 p 25–46 Transl. into ENGLISH from the book "Statisticheskiye Kharateristiki Radiosignalov, Otrazhennych ot Zemnoy Poverkhnosti" USSR, Sovetskoye Publ. House, 1968 p 192–217 (See N69-16928 06-07)
Avail: CFSTI

Problems encountered in the construction of radio engineering installations operating on signals reflected from the ground are analyzed. Parameters for calculating reflected signal strength are formulated; these include surface structure, type of emission, length of pulse, and angle of sight. Errors in determining the motion parameters for aircraft carrying the radio relay lines are analyzed; these errors in measurement are caused by the incidental nature of the reflected signal. Finally, the determination of surface structure characteristics according to the signals reflected from it and the requirements for practical implementation of this method are treated. A.C.R.

N69-16943*# Oklahoma State Univ., Stillwater. School of Electrical Engineering.
A RELOOK AT ROCKET RADAR GROUND ECHO DATA
B. L. Basore 24 Dec. 1968 14 p ref Prepared for JPL
(Contracts NAS7-100; JPL-952355)
(NASA-CR-73735; JPL-TR-68-568) Avail: CFSTI CSCL 17I

In a NASA supported experiment conducted by JPL, an Aerobee Rocket carried an L band radar to an altitude of 166 km over White Sands Missile Range in southern New Mexico. Data recorded during this flight included echoes received both cross and copolarized with the transmitter. This paper described an analysis of a small fraction of the data in which an attempt has been made to understand the mechanisms producing cross-polarized return and how these mechanisms affect the data. Author

N69-16989*# Franklin Inst., Philadelphia, Pa. Research Labs.
[RESEARCH IN LIFE SCIENCES INSTRUMENTATION PERTINENT TO STUDIES IN SPACE BIOLOGY] Quarterly Report, 1 Oct.–31 Dec. 1968
31 Dec. 1968 6 p
(Contract NSr-39-005-018)
(NASA-CR-73750-Q-B2299-15) Avail: CFSTI CSCL 09F

Modifications in the multichannel telemetry and transducers are reported. In connection with the telemetry, transmission through saline solution was overcome by inserting a dielectric barrier and increasing the oscillator input power. Circuit layout and wiring diagrams for a four-channel package are stated to be in progress. Testing and selection of sealant materials, and fabrication and characteristics of iridium electrodes for the transducers are described. Attempts are also described to evaporate KCl solution an Ag–AgCl electrode surface leaving KCl crystals. N.E.N.

N69-17000*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF SIDELOBE SUPPRESSION TECHNIQUES FOR REFLECTOR TYPE SPACECRAFT ANTENNA Final Technical Report
F. J. Goebels, Jr., R. Maier, and R. K. Thomas 1 Sep. 1968 98 p refs
(Contract NAS3-9717)
(NASA-CR-72462) Avail: CFSTI CSCL 09F

Several near axis sidelobe suppression techniques for circularly-polarized, reflector-type of antennas were identified, investigated, tested, and evaluated. Heavy taper, blockage compensation and active zone suppression techniques were simultaneously applied to a 13-wavelength diameter paraboloid. This achieved -40 db sidelobes for linear polarization. A demonstration of sidelobe suppression for circular polarization was precluded by a helical primary feed problem. Only 3.3 percent of the total rf power radiated was supplied to the helical suppressor elements. Author

N69-17090# Joint Publications Research Service, Washington, D. C.
DEVELOPMENTS IN INDUSTRIAL TV AND RADIO FROM THE USSR
10 Jan. 1969 25 p refs Transl. into ENGLISH from Radio (Moscow), no. 11, 1968 p 33-35; 44-47
(JPRS-47231) Avail: CFSTI

CONTENTS:
1. COLOR TELEVISION IN SCIENCE AND ENGINEERING B. Zhebel et al p 1-6 (See N69-17091 06-07)
2. A TELEVISION CAMERA ON THE OCEAN FLOOR V. Marakuyev p 7-11 (See N69-17092 06-07)
3. DETAILS OF SOKLO-4 RADIO RECEIVER GIVEN S. Gondsov et al p 12-22 (See N69-17093 06-07)

N69-17091# Joint Publications Research Service, Washington, D. C.
COLOR TELEVISION IN SCIENCE AND ENGINEERING
B. Zhebel et al *In its* Develop. in Ind. TV and Radio from the USSR 10 Jan. 1969 p 1-6 (See N69-17090 06-07)
Avail: CFSTI

New and varied uses of color television in science and engineering are presented. Some of the specific industrial, medical, and scientific applications discussed are: (1) metallurgical processing of matals; (2) remote control of production processes in steel-rolling mills; (3) viewing of surgical operations; (4) quantitative mineralogical analysis of rock; (5) calorimetrical analysis of plant and animal cells; and (6) colorimetric measurements based on brightness and chromaticity. A.L.

N69-17092# Joint Publications Research Service, Washington, D. C.
A TELEVISION CAMERA ON THE OCEAN FLOOR
V. Marakuyev *In its* Develop. in Ind. TV and Radio from the USSR 10 Jan. 1969 p 7-11 (See N69-17090 06-07)
Avail: CFSTI

The ever-increasing role of television in the study of the marine world and the execution of various submarine operations are discussed. The area of application of underwater television sets depends on the depth range for which they have been designed. Generally they can be separated into three types: (1) shallow water sets for diving operations, laying pipelines and cables, emergency rescue operations, and installation of oil-drilling equipment; (2) medium depth sets for studying sound scattering layers in ocean, composition and shoal density of fish, biological observation of bottom fauna and flora, and small-scale relief studies of the ocean bottom; and (3) deep water television sets for scientific research in the field of geology and biology of the ocean floor and observations in zones which cannot be observed by means of illuminators. Examples of specific applications of the three types of sets are given. A.L.

N69-17093# Joint Publications Research Service, Washington, D. C.
DETAILS OF SOKOL-4 RADIO RECEIVER GIVEN
S. Gondsov et al *In its* Develop. in Ind. TV and Radio from the USSR 10 Jan. 1969 p 12-22 (See N69-17090 06-07)
Avail: CFSTI

The Soviet SOKLO-4 radio receiver is described as a small-scale superheterodyne assembled from eight transistors and two semiconductor diodes. It was designed for receiving local and long-range radio broadcast stations operating in the long, medium, and shortwave frequency ranges. The receiver is equipped with both an internal magnetic antenna and a telescopic antenna. An external antenna may be attached to the set to increase the reception of weak signals. The receiver is equipped with a built-in speaker, as well as a set of earphones for individual listening. The unit is powered by four dry cells with a total voltage of 6 volts. A schematic and circuit diagrams are presented along with detailed descriptions of the overall design of the basic assemblies. A.L.

N69-17122 Princeton Univ., N. J.
REPRESENTATIONS OF COMPLEX-VALUED VECTOR PROCESSES AND THEIR APPLICATION TO ESTIMATION AND DETECTION
Hisashi Kobayashi (Ph.D. Thesis) 1967 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-8937

This dissertation discusses mainly estimation and detection problems for complex-valued vector processes. Multiple observations of radar pulses or diversity reception in communication systems, for example, are conveniently treated by vector process techniques. Moreover, many signal and noise processes treated in communication systems are narrow-band; therefore complex-valued vector process representation will be the most appropriate setting for analysis of many communication systems. Dissert. Abstr.

N69-17140#
OPTIMAL DETECTION OF A SIGNAL WITH KNOWN PARAMETERS
V. B. Pestriakov [1968] 11 p Transl. into ENGLISH from "Fazovye Radiotekhnicheskie Sistemy" Moscow, Sov. Radio Press, 1968 p 219-234
Avail: CFSTI

An optimal processing procedure, or an optimal reception circuit for detection of a signal with known parameters, is sought. The relationships obtained show what is the optimal procedure or algorithm of mixture processing, or what is the optimal reception scheme. As is seen from the formulas, the mixture delivered to the receiver-display input in the optimal scheme should be multiplied by the signal (more accurately, by a copy of the signal), i.e., the receiver-display should generate a copy of the signal, then after integration the result is delivered to the threshold or the comparator unit. If the quantity at the integrator output exceeds the threshold, the signal is considered to exist; if it does not reach the threshold the consideration is that there is no signal. The scheme realizing the optimal procedure is depicted. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N69-16140*# Stanford Research Inst., Menlo Park, Calif.
HUMAN INTELLECT AUGMENTATION TECHNIQUES Final Report
D. C. Engelbart Washington NASA 1969 78 p refs
(Contract NAS1-5904)
(NASA-CR-1270) Avail: CFSTI CSCL 09B

A multiproject program that is exploring the value of computer aids to augmenting human intellectual capability is discussed. Outlined briefly are the background and the "bootstrapping" nature of the program (e.g., the report was produced with the experimental computer aids) and its status at the start of this project. Advances during the project were in the programming system (CRT on-line debugging, etc.),in both off-line and on-line computer-aided text-manipulation systems implemented on a CDC 3100, and in specifications, designs, and nearly completed implementation of a

time-shared system on the SDS 940, which will be committed to serving 12 on-line CRT consoles for this program. Special features of the design included commercial-TV display consoles, special equipment to reduce CPU overhead to a few percent for servicing I/O, a new machine-oriented, systems programmer compiler language, a compiler-compiler, and a Control Metalanguage Translator for compiling the interactive part of the on-line system from a special Control Metalanguage description. Author

N69-16164 Pennsylvania Univ., Pa.
RECOGNITION OF GENERAL LINE PATTERNS WITH APPLICATIONS TO BUBBLE CHAMBER PHOTOGRAPHS AND HANDPRINTED CHARACTERS
Michael Nir (Ph.D. Thesis) 1967 202 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 68-9226

A general method for the recognition of drawings composed of line-like elements is described. Generality is achieved by approximating any pattern presented for recognition by a tree of straight line segments, which makes it possible to describe the structure of any pattern explicitly by a concise code which has been developed for this purpose. This description allows direct comparison of patterns and also the lexicographical ordering of the patterns. By entering the patterns which are acceptable in the class being considered into such an ordered list, patterns which are similar in a certain sense are grouped together. The system handles the input data as provided by the digitizing equipment, without any preprocessing. Dissert. Abstr.

N69-16172# Probe Consultants, Inc., Phoenix, Ariz.
AUTOMATIC REPROGRAMMING WITH THE PILER SYSTEM
Penny Barbe Nov. 1968 24 p refs
(Contract N00014-67-C-0472)
(AD-679237; PLR-002) Avail: CFSTI CSCL 9/2

The PILER System accepts a machine language program as input, and produces a program in a compiler language and a flow chart of the program. The heart of the system is an analyzer which discerns not only what a program is doing, but in many cases it determines why certain sequences of instructions are performed. To generalize the PILER system, the analyzer is isolated from the input-output phases of the translation. This allows numerous instruction interpreters to be written so that any number of computer models can serve as the source computer; and it makes possible any number of output routines for various compiler languages. Thus a very large combination of source-target computers can use the system, while only one major development effort is required for the analyzer. Other features of the system include flagging, with references to the flow chart, for program blocks which cannot be adequately expressed in the specified compiler language, and a feedback system which allows changes to the flowchart to be accepted and the program changed accordingly. Author (TAB)

N69-16176# Rome Air Development Center, Griffiss AFB, N. Y.
A W-MACHINE ASSEMBLER AND SIMULATION Final Report
Frederic A. Dion Nov. 1968 83 p refs
(AD-679211; RADC-TR-68-374) Avail: CFSTI CSCL 9/2

A W-machine is a conceptual device which is the theoretical equivalent to a two-symbol Turing machine but which more closely than a Turing machine resembles a general purpose computer. This report describes an assembler which has been generated for a W-machine. A program which accepts and processes W-machine programs written in the assembly language, simulates the operation of a W-machine and outputs the results, is presented. Sample W-machine programs and their results are illustrated along with the use of the assembler and its error returns. The assembler and the simulation are offered to teachers and students as useful instructional devices which can bridge the gap between some of the theoretical abstractions of information processing theory and the practical realities of computer programming. Author (TAB)

N69-16184# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
DUALITY IN DISCRETE PROGRAMMING: 4. APPLICATIONS
Egon Balas Oct. 1968 52 p refs
(Contract Nonr-760(24))
(AD-678733; RR-145) Avail: CFSTI CSCL 12/2

The paper develops a method for solving integer and mixed-integer nonlinear programs whose objective and constraint-functions are differentiable and concave (convex) on the set of nonnegative variables (i.e. on the domain obtained by disregarding the integrity conditions). Author (TAB)

N69-16187 Pittsburgh Univ., Pa.
OPTIMAL CONTROL OF MULTIVARIABLE DYNAMIC SYSTEMS THROUGH LINEAR PROGRAMMING
Mark Kynaston Enns (Ph.D. Thesis) 1967 176 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-9741

The methods reported were developed specifically to achieve better control of a pressurized-water reactor (PWR) power plant, subjected to a large load disturbance. This, of course, only provides a starting point for the work and a check on its practicality. As finally developed, it may be said that the purpose is to allow one to compute optimal control trajectories and to use these trajectories for the basis of an on-line optimal control of a linear, multivariable dynamic system. An example is carried through for the optimal control of a PWR power plant represented by a 21st-order model with three controls. A simple feedback control is devised to give close-loop stability and optimal trajectories are computed for the entire plant-feedback system. The behavior under optimal control is compared with that for feedback alone to show the benefits obtained: closer control with smaller actuator capacities. The effects of subsequent disturbances are considered. Dissert. Abstr.

N69-16190 Washington Univ., Seattle.
AN ADAPTIVE TREE PRUNING SYSTEM: A LANGUAGE FOR PROGRAMMING HEURISTIC TREE SEARCHES
Edward Walter Kozdrowicki (Ph.D. Thesis) 1967 229 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 68-9302

The tree pruning system (TPS) consists of a set of system statements which can be used as instructions for programming heuristic tree searches. This system is imbedded in FORTRAN so a user can have full benefit of that language. Heuristic programming is often used on problems which require a nonuniform tree structured data formation. The TPS is specifically designed to handle such data structures with facility. Heuristic programming usually consists of searching through a large space of solution attempts using whatever clues or tricks are available to cut down the quantity of searching required. Decisions about each succeeding step in construction of the search tree are made automatically either on the basis of user specification or machine experience. As a search tree is assembled the TPS records various score differences which are used to calculate chance of occurrence. Dissert. Abstr.

N69-16208 Pittsburgh Univ., Pa.
THE METHOD OF ARBITRARY CHOICE FOR TRAINING LINEAR PERCEPTRONS
David A. Forejt (Ph.D. Thesis) 1967 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-9742

The most widely used technique for training linear perceptrons, the fixed-increment error-correction method, is presented and its

disadvantages are discussed. The major disadvantage is that it is an iterative process and convergence can be a serious problem for two reasons: (1) the rate of convergence may be slow; or (2) in the case of pattern classes which are not linearly separable, the process does not converge at all. The method of arbitrary choice overcomes these problems because it is not an iterative process. Upper bounds on the number of operations required by the method of arbitrary choice are derived which are valid even when the pattern classes are not linearly separable. This method has the additional ability of fitting the solution hyperplane through a particular point. The theoretical basis of the method of arbitrary choice is presented and its similarities to linear programming are discussed. A case study made on digital computer on ten training problems is presented. Dissert. Abstr.

N69-16251# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MOCK-UP OF A CRYOTRON DIGITAL COMPUTER WITH PROGRAMMED CONTROL

Ya. S. Kan 7 Mar. 1968 14 p refs Transl. into ENGLISH from Mekhan. i Avtomat. Upr. (USSR), no. 3, 1966 p 19–23
(AD-678814; FTD-MT-24-348-67) Avail: CFSTI CSCL 9/2

A small-scale model of a cryotron computer was built and tested at the Physico-technical Institute of the Academy of Sciences UkrSSR. The model contained only essential blocks such as the arithmetic unit, number memory unit, instruction memory with machine halt unit, control unit, and an I/O unit. The model could add, subtract, and multiply 4-bit (including sign bit) words in fixed-point notation. Instructions were of the three-address type, and the memory unit was random-access. The computer was built using 504 lead-tin wire cryotrons mounted on micarta cards. Three tests lasting 11, 17, and 21 hours were made during which every 3 hours the machine was stopped while liquid helium was added. No malfunctions were encountered. Certain simple algorithms were tried out using eight 9-bit instructions. It was established that multiplication required 3 sec and subtraction 5 sec of machine time; clock period was therfore made equal to 6 sec. The authors state that the test conditions were not optimal in the sense of maximum speed, and propose certain modifications which would bring the computing speed into the megacycle clock-frequency range. Author (TAB)

N69-16258# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN EFFECTIVE METHOD OF MONITORING THE WORK OF AUTOMATA

A. V. Petrosyan 4 Jan. 1968 12 p refs Transl. into ENGLISH from Tr. Vychislitelnyi Tsentr. (Erevan), v. 3, 1965 p 52–57
(AD-678796; FTD-MT-24-385-67) Avail: CFSTI CSCL 9/2

This method is described insofar as it applies to data-processing devices (DPD) whose general design principles are such that ideally they should operate as deterministic automata B but, owing to the unreliability of their design components, they actually operate as probabilistic automata A. Thus, the problem is to develop a control device C which determines whether the states of the homomorphic automata A and B are co-incident; if they are not, this indicates the presence of a malfunction. Author (TAB)

N69-16288# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHODS USED FOR PROBLEM SOLUTION WITH UNIVERSAL COMPUTER SYSTEMS

Yu. G. Kosarev 17 Jan. 1968 38 p refs Transl. into ENGLISH from Akad. Nauk SSSR Sibirsk. Otd. (USSR), no. 17, 1965 p 81–99
(AD-678777; FTD-HT-23-1417-67) Avail: CFSTI CSCL 9/2

It is assumed that the algorithm is written in the form of a finite string composed of a given set of operators, left and right curved brackets, and predicates. A universal computing system consists of units each possessing a maximum volume of stored information and a maximum number of realizable operations in its repertoire. Author (TAB)

N69-16290# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SWITCHING CODES

K. O. Shepelenko 13 Feb. 1968 11 p Transl. into ENGLISH from the book "Vychislitelnaya Tekhnika" Minsk, Nauka i Tekhn., 1965 p 31–36
(AD-679373; FTD-HT-23-1521-67) Avail: CFSTI CSCL 9/2

A switching code which reduces computer loading and increases efficiency is proposed by the author. Switching codes are codes in which the ones correspond to reversal of the symbols (0 and 1) of the original code words (from 0 to 1 and from 1 to 0). TAB

N69-16309*# ADCOM Inc., Cambridge, Mass.

INVESTIGATION AND ANALYSIS OF TIME CODES Final Report

7 Jan. 1968 47 p ref
(Contract NAS5-10540)
(NASA-CR-96390; G-110) Avail: CFSTI CSCL 09D

The present report is aimed principally at developing the concept of a practicable optimal time code system, and at a comparison of the performance of the optimum system with that of the existing NASA and IRIG systems in order to determine the margin of improvement possible over the existing systems. The system concept advocates capitalization on the optimality of correlation detection as the technique for extracting time marker location information. Accordingly, the use of binary-sequence waveforms that utilize the available time frame in various interesting ways is examined, with emphasis on the autocorrelation properties of each waveform. In this way a practical basis for the optimal frame utilization strategy and time code signal design is established. The performance achievable with the resulting frame synchronization sequences is then analyzed, and a comparison is made with sequences typical of current NASA and IRIG systems. A summary is given of conclusions and recommendations. The highlights of the performance comparison of the optimal and the current systems are restated. Author

N69-16366# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INDUSTRIAL CONTROL COMPUTERS

Ying-chiang Cheng 3 Nov. 1967 10 p Transl. into ENGLISH from Tien-Tzu Chi-Shu (Shanghai), no. 7, 1966 p 23–25
(AD-678613; FTD-HT-23-1175-67) Avail: CFSTI CSCL 9/2

The author discusses mode D control machine for industrial production. An industrial control machine is required to have a higher operating reliability than conventional general-purpose computers and can be used for production evaluation and analysis, troubleshooting, alarm signaling, and process control. Principal components are a calculator, a controller, an inner storage device, an outer magnetic drum, an input and output circuit comprising photoelectric reading devices and electric typewriters, a program input section, a program output section, and an operation control station. The program input section uses a reed type relay for sampling, a solid-state differential amplifier as the digital preamplifier, and an analog-digital converter. The program output section comprises a digital-analog converter, a servomotor, and a distributor. Technical specifications of model D control machine are: number system adopted, binary; type of operation, synchronous operation in parallel; operating frequency, 500kc; operating speed, 10,000 times/sec (average); type of address, single address (variable); number of instruction codes, 64; storage capacity, 8192 characters for inner storage and 30,000 characters for outer magnetic drum. TAB

N69-16376# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGN OF UNIVERSAL COMPUTER EQUIPMENT: THEORETICAL FOUNDATIONS
E. V. Yevreinov 5 Feb. 1967 55 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR (Novosibirsk), no. 16, 1965 p 3–72
(AD-678686; FTD-HT-23-1418-67) Avail: CFSTI CSCL 9/2

Properties of a computational environment with individual behaviour of the elements, and features of its realization are investigated. The computational environment consists of identical universal elements; each realizes the full system of algebra logic functions, signal delay, and a full system of switching functions to other elements, and possesses the capability of tuning the elements for the completion of the indicated functions. Questions related to the tuning of the computational environment are considered. Methods of tuning are disclosed. Variants of physical realization of the elements are considered. Logical systems of computational environment elements are considered. Examples of registers, counters, decoders, adders and memory systems are presented. Producibility, flexibility and reliability of the computational environment are noted. TAB

N69-16395# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POSSIBLE CRITERIA FOR EVALUATING INFORMATION RELIABILITY OF MAGNETIC STORAGE DEVICES
V. B. Smolov et al 11 Mar. 1968 15 p refs Transl. into ENGLISH from the book "Magnitnyye Elementy Vychislitel'noy Tekhniki" Moscow, Izd. AN SSSR, 1966 p 164–169
(AD-679386; FTD-MT-24-21-68) Avail: CFSTI CSCL 9/2

The typical magnetic direct-access memory (MDAM) may be divided into two parts: the magnetic memory itself based on cores with a rectangular hysteresis loop (RHL) and the electronic control device for data loading and extraction. Since the design reliability of the magnetic memory (MM) is extremely high, in this case a more important consideration is the effect of internal and external noise, which may distort the stored information. The performance of MDAM in the presence of noise may be assessed by means of the criterion of its information reliability, construed as the ability of the device to store and issue reliable information in the presence of noise, or as the ratio of useful signal to noise. Various types of MM may be compared from the standpoint of the coefficient of selective capability, i. e., the ratio of the minimal current switching a selected core to the maximal noise current in the memory. The design and calculation of MM should assure large tolerances for deviations of all the parameters from their rated values. Thus the reliability of memory elements can be maximized and their cost reduced in view of the attendant relaxation of certain requirements. Working currents of the MM represent the critical parameter whose deviations principally determine the reliability of the MM. TAB

N69-16426# Systems Research Labs., Inc., Dayton, Ohio.
IMPLEMENTATION OF LIE GROUP TRANSFORMS OF SPATIAL DATA ON PARALLEL LOGIC ARRAYS
Robert M. Colomb Aug. 1968 19 p refs
(Contract F19628-67-C-0150)
(AD-678555; SRL-606006-3; AFCRL-68-0443; SR-3) Avail: CFSTI CSCL 9/2

Much data currently being considered for automatic processing is spatial in nature, and some of the noise to which this data is subject is due to smooth geometric distortions such as rotation which can be represented as Lie Group transforms. This report considers ways in which these transforms can be implemented on two-dimensional parallel logic arrays and also describes some ways of taking advantage of the Lie algebra structure of the transformation generators. Author (TAB)

N69-16493*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH: COMBINATORIAL COMMUNICATION
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 192–193 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 09B

A result on exponential sums in finite fields is applied to bound the cross-correlation of a maximal length sequence with any phase shift of the reverse sequence. The result can also be applied to bound the non-zero weights of a certain $(2^k-1, 2k)$ cyclic code. Author

N69-16566 Illinois Univ., Urbana.
A GENERATOR FOR TRANSLATORS OF CERTAIN PROBLEM ORIENTED LANGUAGES
Edward Lile Murphree, Jr. (Ph.D. Thesis) 1967 243 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 68-8179

A method is presented for the automation of the production of processors for problem-oriented languages (POLs). The theory for the processor is based on syntax directed translation and is described in graph-theoretic terms. A prototype translator generator program, coded in FORTRAN 2, is presented and fully documented by annotated listings and flow charts. Considerable effort was made to produce a program which is nearly machine-independent. Utility subroutines, versions of which are given for the IBM 1620 and IBM 7094, for certain shifting and logical operations are readily prepared for virtually any digital computer, thus making it possible to transfer POL processors between machines with a minimum of effort. Use of the system is explained through two examples, a linear programming language and a subset of the STRESS language. Dissert. Abstr.

N69-16570# Bull General Electric, Paris (France).
INTERNATIONAL SYMPOSIUM ON INFORMATION THEORY, EMPYREAN, AN ALTERNATIVE PARADIGM FOR PATTERN RECOGNITION
Morton Nadler 1968 20 p refs
(PB-179834) Avail: CFSTI CSCL 09B

It is pointed out that along with the measurement subproblem and the decision subproblem of pattern recognition, there exists the feature-extraction subproblem. A general structure is proposed, consisting of an 'ascending hierachy' of sequential machines which transduce the input word (measurement vector) to a set of pattern description vectors, and a descending hierarchy of finite state pattern recognizers (automata). An iterative procedure for constructing the latter for prescribed statistical performance is given, with certain heuristics employed in state reduction of the resulting automata to yield certain types of extrapolations. A comparison is made with the analogous approach of Hunt, Marin, and Stone. Author (USGRDR)

N69-16602# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEMICONDUCTOR MULTICHANNEL DIGITAL-TO-ANALOG CONVERTER WITH A VOLTAGE MEMORY
V. G. Katyushkin 12 Jan. 1968 11 p refs Transl. into ENGLISH from Vychislitel'naya Tekhn. v Upr. (Moscow), 1966 p 191–196
(AD-678790; FTD-HT-23-1629-67) Avail: CFSTI CSCL 9/5

A semiconductor multichannel digital-to-analog converter is described which was used jointly with a digital computer and which represents a reflection device. The required coordinates are recorded in the storage unit of the digital computer. Then, the storage cyclically delivers a parallel code which is fed to registers. From the latter, the signals go to summation matrices which produce analog voltages. These voltages -- via amplifiers -- are applied to voltage-storage units, from where the signals are fed to deflection devices. Circuits and individual assemblies of the converter are described. TAB

N69-16674# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BUFFER STORAGE DESIGN IN COMPUTER SYSTEMS WITH SEVERAL INCOMING DATA FLOWS
G. P. Basharin 29 Nov. 1967 26 p refs Transl. into ENGLISH from Sistemy Upr. i Kommutatsii, Akad. Nauk SSSR (Moscow), 1965 p 24–41 Presented at A.S. Popov Sci.–Eng. Soc. for Radio Eng. and Elec. Communications, 9 May 1963
(AD-678776; FTD-HT-23-1414-67) Avail: CFSTI CSCL 9/2

In designing information systems of the centralized control type or regulation and computer systems, problems of queuing theory and the investigation of operations arise since these systems contain both informational and computing portions between which data flows circulate. Complex relationships must be solved when selecting computer speed with respect to volume and intensity of information arrival, volume of computations involved in processing one report, and capacity of various types of memories and other parameters of the system. A method for solution of some problems connected with the servicing of an instrument with a finite queue, which can be used in calculation of the capacity of a buffer memory and in many other cases, is presented. Theoretical problems are analyzed, and a numerical example is given in the form of a control system in which the role of the servicing apparatus is played by a digital computer, the input flows of requests being signals from various input channels (transducers). For processing of these signals, the external memory of the computer must store as many programs as there are different channels. The servicing time of each request is determined by the complexity of the program and the time required to re-write the program into the operative memory. A calculation of the buffer memory capacity required between input channels and the computer is performed. TAB

N69-16676# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELF-TEACHING AUTOMATIC SYSTEMS (SELECTED ARTICLES)
13 Feb. 1968 35 p refs Transl. into ENGLISH from the Publ. "Institut Automatiki i Telemekhaniki, Samoobuchayushchiyesya Automaticheskiye Sistemy" Moscow, Izd-Vo Nauka, 1966 p 53–72
(AD-679374; FTD-HT-23-1525-67) Avail: CFSTI CSCL 6/4

CONTENTS:

1. MATRIX METHOD OF PATTERN RECOGNITION AND CERTAIN PROBLEMS IN THE CONSTRUCTION OF STANDARDS V. Y. Trakhtman p 1–9 refs (See N69-16677 06-05)

2. CERTAIN PROBLEMS OF OPTIMUM PATTERN RECOGNITION G. A. Medvedev p 10–18 refs (See N69-16678 06-08)

3. TEACHING PATTERN RECOGNITION IN BOOLEAN SPACE A. D. Zakrevskiy et al p 19–26 refs (See N69-16679 06-08)

N69-16678# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS OF OPTIMUM PATTERN RECOGNITION
G. A. Medvedev *In its* Self Teaching Autom. Systems 13 Feb. 1968 p 10–18 refs (See N69-16676 06-08)
Avail: CFSTI

This article examines problems associated with the structure of a device making a decision in conformity with some situation arising in the external environment. The device receives information through sensing elements. The recognizer has *n* sensing elements, to each of which a certain number *a* is ascribed. It is assumed that each of the sensing elements can be only in one of two states: 1 (excited) and 0 (not excited). The situation arising in the external environment is presented to the recognizer in the form of some realization of an image. A random process, or more conveniently a random vector, is called the pattern. The external environment reflects the presence of only *k* situations, i.e., *k* is the number of all possible different images, the realization of which can be observed by the recognizer. As the result of an analysis a type of neuron is found which provides an optimal state in the sense of minimization of the risk function when recognizing patterns which are random vectors with statically independent components. Author

N69-16679# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TEACHING PATTERN RECOGNITION IN BOOLEAN SPACE
A. D. Zakrevskiy et al *In its* Self Teaching Autom. Systems 13 Feb. 1968 p 19–26 refs (See N69-16676 06-08)
Avail: CFSTI

As one of the ways of solving the problem of pattern recognition and teaching of pattern recognition deserving of attention, the authors investigate appropriate models in Boolean space. The following is assumed as a working hypothesis: the pattern is a Boolean function having a sufficiently simple disjunctive form, i.e., with a small number of low-rank conjunctions. In this case it becomes possible to teach pattern recognition on the basis of relatively short teaching sequences, the length of which is appreciably less than the power of the set. For example, the use of the following principle is reasonable: for a given teaching sequence of fixed length it is assumed that the pattern corresponds to a Boolean function having the simplest disjunctive form (minimal or briefest) and taking from the elements of teaching sequence the values prescribed by this sequence. By increasing the fixed length and forming a corresponding sequence of Boolean functions it is possible to expect that with a sufficiently simple pattern this sequence will converge at a certain limit corresponding to the pattern sought. Author

N69-16695# Adams (Charles W.) Associates, Inc., Watertown, Mass.
INVESTIGATION OF M460/340 DISPLAY OPERATING SYSTEM IMPROVEMENTS Final Report, Mar.–Sep. 1968
Robert M. Metcalfe and J. S. Hermistone Dec. 1968 11 p
(Contract F19628-68-C-0182)
(AD-679133; AFCRL-68-0591) Avail: CFSTI CSCL 9/2

The report contains a summary of the current programming effort on the AFCRL m-460. This effort was expended to develop well-organized and versatile software in support of an evolving, programmer-oriented, on-line operating system. Under this contract the basic software for such an operating system has been written and tested. Author (TAB)

N69-16721# Illinois Univ., Urbana. Dept. of Computer Science.
[CIRCUIT RESEARCH PROGRAM, HARDWARE SYSTEMS RESEARCH, SOFTWARE SYSTEMS RESEARCH PROGRAM] Quarterly Technical Progress Report, Oct.–Dec. 1967
Dec. 1967 266 p refs
(TID-24747) Avail: CFSTI

The circuit research program, hardware and software systems research, the Illinois pattern recognition computer ILLIAC II, ILLIAC IV, numerical methods, computer arithmetic, and artificial languages, computational physics, and switching theory and logical designs are discussed. Also, the service, uses, and program development of ILLIAC II and IBM 7094/1401, problem specifications, and general laboratory information are reported. NSA

N69-16731# Army Materials Research Agency, Watertown, Mass. Materials Research Lab.
FORMATTING PROGRAMS FOR SIMPLIFYING DATA REDUCTION WITH THE PDP-8 FLOATING-POINT SYSTEM
John J. Antal Oct. 1968 42 p refs
(AD-679155; AMMRC-TR-68-18) Avail: CFSTI CSCL 9/2

Several programs having the general name DARIC are described which simulate the reduction of data listed in columns as a function of a single variable, a form familiar to manual data tabulation and reduction in the laboratory. Data is entered at the Teletype ASR keyboard, and calculation is accomplished with the Digital Floating-Point System and the users data reduction program. DARIC automatically increments the single variable, and contains features which simplify the organization of data from diverse and instrument outputs, the accounting of deleted data points, and the writing of the data reduction program. The programs are useful also in computing points for the plotting of theoretical functions. Author (TAB)

N69-16735# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THIN FILM MATRIX MEMORY WITH A CONDUCTIVE SUBSTRATE [ZAPOMINAYUSHCHEYE USTROYSTVO NA TONKOPLENOCHNYKH MATRITSAKH S PROVODYASHCHEY PODLOZHKOY]
Ye. F. Berezhnoy et al *In its* Magnetic Elem. of Computation Tech. 5 Jan. 1968 p 7-15 refs (See N69-16733 06-09)
Avail: CFSTI

A model of a high-speed, destructive-readout film memory with a 500-nsec cycle time is described. The memory is based on four matrix blocks which have a total capacity of sixty-four 56-bit words. An individual storage element is a vacuum-deposited 1.2×2.4 mm magnetic film approximately 1000 Å thick, on a highly-polished duralumin substrate. Each substrate block measures 100×100×4 mm. Read windings are mounted in the easy direction, write and signal windings in the hard direction. Write current does not exceed 120 ma; erase current must be at least 350 ma. Author

N69-16744 Princeton Univ., N. J.
DETERMINISTIC LANGUAGE PROCESSING
Allen John Korenjak (Ph.D. Thesis) 1967 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-8939

The concept of syntax-directed compilation requires that programming language syntax be expressed in an appropriate formal language system. Although a wide spectrum of formal language classes has been defined, programming applications have used the context-free languages almost exclusively. In various attempts to increase the efficiency of language processing, subsets of the context-free languages have been studied, with the hope that they would be sufficiently powerful to model programming language syntax. Each of these subsets is included in the deterministic context-free languages, which have the property that they can be recognized by a pushdown automaton in a single left-to-right-scan. The present work examines two topics related to deterministic language processing. Dissert. Abstr.

N69-16762 National Lending Library for Science and Technology, Boston Spa (England).
QUESTIONS ON THE SOLUTION OF PROBLEMS IN LINEAR PROGRAMMING WITH THE AID OF ANALOGUE COMPUTERS [VOPROSY RESHENIA ZADACH LINEINOGO PROGRAMMIROVANIA S POMOSHCHIU VYCHISLITELNYKH MASHIN]
I. M. Vitenberg et al Oct. 1968 16 p refs Transl. into ENGLISH from Vopr. Teorii i Primeneniya Matemat. Model (USSR), 1965, p 150-165
(NLL-RTS-4845) Avail: Natl. Lending Library, Boston Spa, Engl.: 40 s

A simplified design is proposed for solving a linear programming problem. This is done by substituting movement along the gradient in the first stage by movement in a direction determined by alternate change of only one of the variables, and of chaning the type of movement along the hypervolume boundary. Movement along the hypervolume boundary by changing one of the variables can be effected either by using an electrical simulator circuit for an inequality defining the given boundary, or else by alternate variation of a master variable, the alteration of which leads to a reduction in the value of z, and of an auxiliary variable, the alteration of which ensures departure from the boundary which is necessary for carrying out a change in the master variable. Author

N69-16898# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALOG AND ANALOG-DIGITAL COMPUTER ENGINEERING (SELECTED ARTICLES)
12 Dec. 1967 22 p refs Transl. into ENGLISH from Mashinostr. (Kiev), 1965 p 210-399
(AD-678794; FTD-MT-24-346-67) Avail: CFSTI CSCL 9/2

CONTENTS:

1. MODERNIZATION OF ANALOG COMPUTERS MNB-1 AND MPT-9-2 G. G. Murzin et al p 1-5 (See N69-16899 06-08)

2. CONSTRUCTION OF DIODE FUNCTIONAL CONVERTERS WITHOUT REFERENCE VOLTAGES Ye. I. Lamin p 6-15 refs (See N69-16900 06-09)

N69-16899# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MODERNIZATION OF ANALOG COMPUTERS MNB-1 AND MPT-9-2 [MODERNIZATSIYA ANALOGOVYKH VYCHISLITEL'NYKH MASHIN MNB-1 I MPT-9-2]
G. G. Murzin et al *In its* Analog and Analog-Digital Computer Eng. 12 Dec. 1967 p 1-5 (See N69-16898 06-08)
Avail: CFSTI

Improvements in the design of the MPT 9-2 and MNB 1 computers are described. The modifications were made to improve the technical characteristics of the operational amplifier; to reduce the required power by introducing an economical output stage in the amplifier; and to increase the operational accuracy and reliability with minimal design changes to allow modular interchangeability. Modifications included use of nonreactive hermatically sealed microwire resistance with 0.03% tolerance, reduction in the number of power units, and expansion of the frequency characteristics of the operational sections. The modified computer was assigned the code number MPT 9-3. Author

N69-16924*# Texas Univ., Austin. Electronics Research Center.
STRUCTURE THEORY FOR THE REALIZATION OF FINITE STATE AUTOMATA Final Report, 1 Nov. 1966-31 Oct. 1968
C. L. Coates 31 Oct. 1968 106 p refs
(Grant NGR-44-012-049)
(NASA-CR-73741) Avail: CFSTI CSCL 09B

Research papers are presented which describe results of the investigations in structure theory. (1) The effect the memory element has on the feedback in a sequential machine was investigated. Three different memory elements are studied: the unit delay, trigger flip-flop, and set-reset flip-flop. Methods are given for determining when a sequential machine can be realized. (2) A subclass of the permanent state errors is called inessential and its definition is given. Several results are presented concerning the state partition which imply a method for its computation. An algorithm for determining the partition is stated and illustrated. (3) An algorithm is presented which yields all code assignments for which the state variable and output variable functions are 2-assumable. The algorithm yields all code assignments for which the corresponding threshold gate realizations are one-level. (4) Logic hazards in threshold gate networks are investigated. Three methods

are presented for determining if a given threshold realization contains any logic hazards. Two methods are then presented for synthesizing logic hazard-free threshold realizations. Author

N69-16945# System Development Corp., Santa Monica, Calif.
SPACE PROGRAMMING LANGUAGE (SPL/J6), PROGRAMMER'S MANUAL
Gerard A. Hirschfield and Levi J. Carey Nov. 1968 202 p
(Contract F04701-68-C-0135)
(AD-679139; SAMSO-TR-68-383) Avail: CFSTI CSCL 9/2

This programmer's manual describes the space programming language/jovial 6 (SPL/J6), a dialect of the jovial language designed for spaceborne software applications. The language forms, the notation to be used, and examples of usage are all included. The document is for both reference and training for those unfamiliar with the language. However, it does assume that the reader is familiar with the techniques of computer programming. Author (TAB)

N69-16992# Rome Air Development Center, Griffiss AFB, N. Y.
PROGRAM TRANSFERABILITY STUDY
George H. Mealy, T. E. Cheatham, Jr. (Computer Assoc.), David J. Farber (RAND Corp.), Edward Morenoff, and Kirk Sattley (Computer Assoc.) Nov. 1968 39 p refs
(AD-678589; RADC-TR-68-341) Avail: CFSTI CSCL 9/2

This report treats the problem of transferring programs from one operating environment to another with the expenditure of a small fraction of the initial programming development time and cost. Programs considered range from quite small ones, such as routines for evaluating arctangents, to large and complex systems, such as compilers, data management systems, or command and control systems. The initial and final environments may be slightly or highly dissimilar with respect to machines, machine configuration, or operating systems and languages used. Author (TAB)

N69-16994# California Univ., Los Angeles. Dept. of Engineering.
GRAPH MODELS OF COMPUTATIONS IN COMPUTER SYSTEMS
Jean-Loup E. Baer Oct. 1968 220 p refs
(Contracts Nonr-233(52); ARPA SD-184; AT(11-1)-GEN-10)
(AD-678753; UCLA-10P14-51; Rept-68-46) Avail: CFSTI CSCL 9/2

A directed graph is used as a model for computational tasks. This model shows the precedence constraints, concurrency or mutual exclusiveness between subtasks. The directed graph is transformed into an acyclic graph in such a way that the mean path length of the original cycles are left unchanged. From this graph, mean path length measurements can be performed. Associated with an algorithm examining the structure of the graph, lower and upper bounds on the number of processors referred for maximum parallelism can be determined. A one-shot a priori scheduling with different urgency rules is presented and tested on some example graphs. It presents a large saving of computational time compared to previous experiments. Author (TAB)

N69-17008# RAND Corp., Santa Monica, Calif.
THE SIMSCRIPT 2 PROGRAMMING LANGUAGE. REFERENCE MANUAL
P. J. Kiviat and R. Villanueva Oct. 1968 32 p
(Contract F44620-67-C-0045)
(AD-678867; RM-5776-PR) Avail: CFSTI CSCL 9/2

The memorandum, containing the syntax and semantics of The SIMSCRIPT II PROGRAMMING LANGUAGE, is designed as a reference manual for programmers. TAB

N69-17040# Michigan Univ., Ann Arbor. Systems Engineering Lab.
A STUDY OF A MODEL FOR PARALLEL COMPUTATIONS
Raymond Reiter Griffiss AFB, N. Y. RADC Nov. 1968 200 p refs
(Contract AF 30(602) 3546)
(AD-678957; SEL-67-15; RADC-TR-68-350) Avail: CFSTI 9/2

The report deals with a model for parallel computations as formulated by Karp and Miller. A computation is viewed as a directed graph (computation graph) in which a node represents an operation to be performed upon data on the node input branches with the results of this operation being placed upon the output branches. An integer linear program is given for the determination of the maximum storage required by a computation graph G. The concept is introduced of an admissible schedule defining valid node initiation times. A maximal computation rate quasi periodic schedule is given for the case that G is required to compute synchronously, i.e. at integer times. Finally, for more general computation graphs, an analysis of the so-called free admissible schedule is given. Author (TAB)

N69-17053# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
COMPUTER APPLICATIONS
In its Mod. Technol. Jun. 1968 p 27–67 (See N69-17051 06-11)
Avail: Issuing Activity

Efforts continued on developing techniques for automating the process of constructing specialized languages and programs, and the process of moving programs from one computer to another. Major emphasis was placed on machine independence and the process required to convert the AED (automated engineering design) system programs to new and basically different computers through an almost completely automatic computer technique called bootstrapping. For on-line simulation of electrical networks and systems, in integrated on-line circuit design system, CIRCAL-2, was implemented. A recursive approach for the computer analysis of nonlinear networks is discussed. A program in computer processing of news and journal articles was established, which is closely allied with the information storage and retrieval techniques being developed for the Intrex project. Experimental versions of an unconventional computer-stored augmented library catalog were also developed. M.G.J.

N69-17054# Massachusetts Inst. of Tech., Cambridge Electronic Systems Lab.
COMPUTER TECHNOLOGY AND INFORMATION DISPLAY
In its [Mod. Technol.] Jun. 1968 p 69–104 (See N69-17051 06-11)
Avail: Issuing Activity

Major objectives of the synthesis research for logic networks are cited as specification of powerful logic elements and development of orderly procedures for exploiting them in networks; determination of simple and fixed circuit forms for the realization of broad classes of sequential machines; and checking and diagnosis of logic networks. An overview is presented on the results of a program to apply hybrid computing techniques to the solution of partial differential equations. Design improvements in display systems are discussed in terms of graphics system software, techniques for terminal and intercomputer communications, and hard copy techniques. A block diagram and descriptive data are presented on a multiaccess-computer console design for a computer-based catalog of library information. The console system consists of several user consoles that are connected to a buffer/controller station containing a drum memory, and a small digital computer. Experiments on text access for library information are centered on the transmission of textual images from a noncirculating store of microfilmed documents to remote viewing stations. The system configuration is depicted. M.G.J.

N69-17059# RAND Corp., Santa Monica, Calif.
THE SIMSCRIPT 2 PROGRAMMING LANGUAGE
P. J. Kiviat, R. Villanueva, and H. R. Markowitz Oct. 1968 406 p
(Contract F44620-67-C-0045; Proj RAND)
(AD-678690; R-460-PR) Avail: CFSTI CSCL 9/2

A users and programmers manual for SIMSCRIPT II that requires only a basic knowledge of computers and programming language translators (compilers). Sections that are unusually difficult or contain features of limited use are marked with an asterisk. The manual is divided into five chapters, corresponding to five language levels. Level 1 is a teaching language designed to introduce programming concepts to nonprogrammers. Level 2 is a language roughly comparable in power to FORTRAN, but departs from it in specific features. Level 3 is comparable in power to ALGOL or PL/I, but with specific differences, and contains information on the new ALPHA mode for alpha-numeric manipulations, on writing formatted reports, and on internal editing. Level 4 contains the entity-attribute-set features of SIMSCRIPT, which have been up-dated and augmented to provide a more powerful list-processing capability. Level 5, the simulation-oriented part of SIMSCRIPT II, contains statements for time advance, event and activity processing, generation of statistical variates, and accumulation and analysis of simulation-generated data. Two new debugging routines, BEFORE and AFTER, enable the monitoring of six complex processes.
Author (TAB)

N69-17075# Auerbach Corp., Philadelphia, Pa.
ASSOCIATIVE MEMORY INVESTIGATIONS: SUBSTRUCTURING SEARCHING AND DATA ORGANIZATIONS Final Technical Report
Griffiss AFB, N. Y. RADC Nov. 1968 117 p refs
(Contract AF 30(602)-4309)
(AD-679227; RADC-TR-68-262; Rept-1374-TR-500-1) Avail: CFSTI CSCL 9/2

The purpose of this study was to analyze for associative processing the following test problems: (1) A data retrieval problem for a formatted unstructured file with records which contain multiple-word, fixed-field size items. (2) A data maintenance problem for formatted structured files such that reference checking is required between records of different files. (3) A data maintenance problem for formatted unstructured files of fixed-size, single-word record items such that maintenance of one field is conditional upon another fields value. (4) A data maintenance problem for formatted unstructure files of variable size, multiple word record items such that item values can be maintained without reference to another record. In addition to these data manipulation and retrieval problems, the study of associative processing in substructure searching was performed. More specifically, an algorithm for the search of a substructure contained within a larger structure (a file of such larger structures is assumed) was developed for an associative processor as typified by the Goodyear Associative Processor. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N69-16118 Cornell Univ., Ithaca, N. Y.
ELECTRONIC CHARACTERISTICS OF A QUENCHED MODE GUNN EFFECT OSCILLATOR
Wen Tsuan Chen (Ph.D. Thesis) 1968 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-9433

The electronic characteristics of a quenched mode Gunn effect oscillator was studied both theoretically and experimentally. The theoretical work is based on a large signal analysis and a computer program is used to simulate the Gunn diode in a resonant circuit to predict the domain dynamics, the i-v characteristics and the overall electrical behavior of a quenched mode Gunn oscillator. Good agreement of this theory with many experimental observations is shown. A simple method for measuring the i-v characteristics and the electronic admittance of an oscillating Gunn diode operating in a quenched mode is described. The i-v characteristic and admittance measurements have shown that the diode equivalent circuit is a series combination of a negative conductance in shunt with a cp capacitive susceptance and the low-field region impedance.
Dissert. Abstr.

N69-16218# Hercules Powder Co., Wilmington, Del.
IMPROVED PROPYLENE COPOLYMER DIELECTRICS FOR COMMUNICATIONS CABLE
Vincent E. Walsh 1968 22 p Presented at the 17th Intern. Wire and Cable Symp., Atlantic City, N. J., Dec. 1968
(AD-678550) Avail: CFSTI CSCL 9/1

With a background of high density polyethylenes developed for wire and cable applications, including copolymerization processes, an effort was made to optimize a polypropylene resin having the broadest possible utility as a primary insulation material with a good balance of mechanical, electrical and processing properties. Special emphasis was placed on low temperature performance and processability. Numerous types of copolymer resins were studied in which the percent of comonomer and method of its incorporation were varied. The principal development was through modifications using ethylene as the comonomer.
TAB

N69-16243# Sandia Corp., Albuquerque, N. Mex.
ELECTROMORPHIC CERAMICS IN EXTREME ENVIRONMENT PARAMETRIC DEVICE APPLICATIONS
E. P. EerNisse Sep. 1968 28 p refs Presented at the Appl. of Ferroelectrics Symp., Washington, D. C.
(Contract AT(29-1)-789)
(SC-DC-68-2417; CONF-681011-1) Avail: CFSTI

Diffuse-transition electromorphic ceramics were investigated for parametric device applications in extreme temperature and radiation environments. The circuit properties of nonlinear capacitors fabricated from such materials were found to be relatively constant over a temperature range of hundreds of degrees centigrade and extremely insensitive to nuclear radiation. Because of dielectric relaxation behavior, efficient parametric device applications are limited to below 10 MHz with presently available materials. An antiferroelectric composition provided more efficient parametric amplification at the higher frequencies than did the ferroelectric compositions investigated.
Author (NSA)

N69-16274 Michigan Univ., Ann Arbor.
HARMONIC CONTENT OF A BUNCHED ELECTRON BEAM IN A NONUNIFORM REGION
Herbert Melancthon Federhen (Ph.D. Thesis) 1967 295 p
Avail: Univ. Microfilms: HC $13.30/Microfilm $3.80 Order No. 68-7592

The purpose of this study is to investigate the harmonic content of a klystron electron beam under various conditions of space charge, d-c gradient, and periodic impedance variations in the drift region. A small-signal ballistic analysis is employed to find the basic electronic equation describing the behavior of the beam under these conditions. An analysis is made for several types of d-c potential variation, including linear, exponential, and a general power-law variation of the form $V(z) = V_0(1+cz)^n$. When the effects of d-c space charge are included, a potential minimum will form in the bunching region. Closed-form solutions are found for each of the cases considered, and numerical values are presented for two typical klystrons.
Dissert. Abstr.

N69-16351# Illinois Univ., Urbana. Coordinated Science Lab.
AN ALGORITHM FOR NAND DECOMPOSITION OF COMBINATIONAL SWITCHING SYSTEMS
Edward S. Davidson May 1968 245 p refs
(Contract DAA807-67-C-0199)
(AD-678558; R-382) Avail: CFSTI CSCL 9/5

A branch-and-bound algorithm is presented for the synthesis of multi-output, multi-level, cycle-free NAND networks, to realize an arbitrary given set of partially or completely specified combinational switching functions. Minimum cost solutions are obtained under a specified cost function which may be any non-negative integer linear combination of the number of gate inputs and gates of a solution network. Other solutions, not necessarily of minimum cost, are produced by the algorithm during the search for a minimum cost solution. A wide variety of network constraints are compatible with the algorithm and can easily be introduced. The completeness, consistency, and finite convergence of the algorithm are proven. Several versions of the algorithm are implemented in computer programs. Strategies for the final version of the algorithm are selected both on the basis of experimental results with these implementations and on the basis of more theoretical justification. Finally, the effectiveness of the approach and its relative effectiveness with respect to other approaches are tested with a set of broadly varied synthesis problems. Author (TAB)

N69-16386# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIGITAL SMOOTHING FILTERS
A. I. Bobikov et al 1 Mar. 1968 19 p refs Transl. into ENGLISH from the book "Metody i Sredstva Preobrazovaniya Informatsii" Kiev, Nauk. Dumka, 1966 p 116–126
(AD-678819; FTD-MT-24-11-68) Avail: CFSTI CSCL 9/5

Digital filters with infinite transient time have a low order of astatism, i.e., high dynamic error. The present article offers a method for synthesizing digital filters with infinite transient time which can smooth down and also transform the signal; their order of astatism can be made sufficiently high. A filter with an exponential weight function and an infinite transient time is equivalent (as far as reproduction of linear signal and smoothing of noise are concerned) to a filter with finite transient time that has a rectangular weight function. Block diagrams of the new filter for 0, 1, and 2 orders of astatism are shown. TAB

N69-16411# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN INDUCTIVE RELAXATION OSCILLATION BASED ON A TUNNEL DIODE AS A FREQUENCY CONVERTER IN AN ASTATIC VOLTAGE STABILIZER
P. P. Treys 8 Mar. 1968 14 p refs Transl. into ENGLISH from Sistemy Upr. i Peredachi Inform. v Elektroenergetike (Moscow), 1966 p 184–190
(AD-679387; FTD-MT-24-39-68) Avail: CFSTI CSCL 9/5

A block diagram of an astatic voltage stabilizer is given. The stability of the output voltage from this circuit is determined by the stability of the pedestal frequency f sub 0 and the operating stability of the frequency converter. The pedestal frequency is stabilized by using a quartz oscillator. However, the stability of conventional transistorized relaxation oscillators with magnetic coupling used as frequency converters is less than 0.1%. Frequency converters of this type are also limited in possibilities for controlling output voltage at a constant pedestal frequency. The author shows that these disadvantages may be overcome by using an inductive relaxation oscillator based on a tunnel diode. TAB

N69-16428# Discon Corp., Fort Lauderdale, Fla.
DIGITAL SELECTOR SWITCH Final Report
R. F. Degroof May 1968 19 p
(Contract DA-28-017-AMC-2382(A))
(AD-679224) Avail: CFSTI CSCL 9/5

The report discusses work performed on a digital selector switch which previously had feasibility and basic design concepts proven. The digital switch function is to allow an operator to set time from 0.1 to 999.9 seconds into an electronic timer by switching any combination of fifty(50) circuits. Author (TAB)

N69-16436# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE ELECTRICAL PROPERTIES OF SOME HEAT-RESISTANT SYNTHETIC FILMS USED IN MAKING CAPACITORS
E. M. Kostenko 28 Mar. 1968 10 p refs Transl. into ENGLISH from Tr. Politekhn. Inst. SSR (Leningrad), no. 276, 1967 p 21–25
(AD-678808; FTD-HT-23-153-68) Avail: CFSTI CSCL 9/1

The results are reported of an experimental study of electrical properties of 10-20 micromoles thick polytetrafluoroethylene (PTFE), polyethylene terephthalate (PETP), and polycarbonate (PC) films. As these films are only slightly hygroscopic, vacuum-sprayed Ag electrodes were used. To prevent dimensional instability, teflon was preheated for several hours at 250C before its electrical properties were measured. Author (TAB)

N69-16490*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT RADIO
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 169–170 (See N69-16475 06-07)
Avail: CFSTI CSCL 09A

Mechanical and electrical design information is presented on an experimental electrostatically focused amplifier (ESFA) which uses a radiation-cooled collector system. Developed for advanced S-band (2295 MHz) spaceborne transmitter tubes, the ESFA demonstrated that the radiating collector technique is usable. M.G.J.

N69-16517*# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
RESEARCH INTO ADVANCED CONCEPTS OF MICROWAVE POWER AMPLIFICATION AND GENERATION UTILIZING LINEAR BEAM DEVICES Semiannual Status Report, Dec. 1968
P. R. McIsaac Dec. 1968 24 p refs
(Grant NGL-33-010-047)
(NASA-CR-99267) Avail: CFSTI CSCL 09A

This report summarizes work done on a theoretical study of some aspects of the interaction between a drifting stream of electrons with transverse cyclotron motions and an electromagnetic field. Particular emphasis is given to the possible generation and amplification of millimeter waves. The report includes a discussion of the conditions for amplification, both forward wave and reverse wave, when a spiraling filamentary electron beam interacts with the transverse electromagnetic waves of an uniform circuit, and also gives some start-oscillation data for a reverse wave oscillator. The relativisitic origins of the amplification and oscillation are discussed. Author

N69-16558*# Bendix Corp., Southfield, Mich. Research Labs.
RESEARCH AND DEVELOPMENT ON CHANNEL MULTIPLIERS FOR CHARGED-PARTICLE DETECTION Final Report, 23 Apr. 1964–24 Jun. 1967
24 Jun. 1967 40 p refs
(Contract NAS5-3842)
(NASA-CR-99269; Rept-4661) Avail: CFSTI CSCL 09A

CONTENTS:

1. CONTINUOUS CHANNEL ELECTRON MULTIPLIER OPERATED IN THE PULSE SATURATED MODE K. C. Schmidt and C. F. Hendee 13 p refs (See N69-16559 06-09)

2. CALCULATION OF OPTIMUM DESIGN PARAMETERS FOR A THREE-TERMINAL CURVED CHANNEL MULTIPLIER 4 p refs (See N69-16560 06-09)

N69-16559*# Bendix Corp., Southfield, Mich. Research Labs.
CONTINUOUS CHANNEL ELECTRON MULTIPLIER OPERATED IN THE PULSE SATURATED MODE
K. C. Schmidt and C. F. Hendee *In its* Res. and Develop. on Channel Multipliers for Charged-Particle Detection 24 Jun. 1967 13 p refs (See N69-16558 06-09)
Avail: CFSTI CSCL 09A

Peaked pulse height distributions are obtained from curved channel electron multipliers at high gain levels. They are caused by a gain saturating mechanism which limits the instantaneous output current from the multiplier. Various limiting mechanisms are considered. Experimental and theoretical evidence strongly supports the hypothesis that space charge limiting is the major cause of gain saturation. Author

N69-16560*# Bendix Corp., Southfield, Mich.
CALCULATION OF OPTIMUM DESIGN PARAMETERS FOR THREE-TERMINAL CURVED CHANNEL MULTIPLIER
In its Res. and Develop. on Channel Multipliers for Charged-Particle Detection 24 Jun. 1967 4 p refs (See N69-16558 06-09)
Avail: CFSTI CSCL 09A

Calculated were lengths and respective resistances of both sections of a two-piece channel multiplier which will allow the maximum dynamic range for a given power dissipation. Author

N69-16604# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME RESULTS OF TEMPERATURE FIELD STUDIES IN COOLED ELECTRIC ARC HEATER COMPONENTS ON COMPOSITE ELECTRIC MODELS
L. A. Kozdoba et al 16 Feb. 1968 13 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 7, no. 9, 1964 p. 78-82
(AD-679368; FTD-HT-23-1309-67) Avail: CFSTI CSCL 13/1

A composite electric model was used to study the temperature fields on an arc heater anode and cathode under steady state conditions. The investigation included the geometric details of the electrodes, the change in external heat source (Ki), and the Bi change on the cathode internal surface and anode external surface. The thermal conduction problem is solved assuming axial symmetry with boundary conditions of second kind on the cylinder exterior surface and boundary conditions of the third kind on the internal cylindrical surface. For the anode, temperature fields were calculated in the range Bi = alpha R sub 1/lambda = 1.08 to 4.32 and Ki = 1.36 to 0.41. For the cathode, the corresponding ranges were: Bi = 3.395 to 13.58 and a variable Ki. Nondimensional temperature versus anode wall thickness curves show a minimum temperature near the arc burn. This phenomenon is explained by the temperature distribution in the longitudinal section of the electrode when a concentrated heat source acts on one surface and a boundary condition of third kind is prescribed at the other. TAB

N69-16643*# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
PHOTON-COUPLED ISOLATION SWITCH Final Report, 1 Jan. 1966-31 Mar. 1968
E. L. Bonin 31 Mar. 1968 106 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951340)
(NASA-CR-73640; Rept-03-68-78) Avail: CFSTI CSCL 09A

Optoelectronic techniques were used to develop a new type of photon-coupled integrated circuit. This device, called the photon-coupled isolation switch, uses internal photon generation and detection to provide electrical isolation between the driving sources and all other terminals of the switch. The isolation switch combines a monolithic silicon (Si) integrated driver circuit, a gallium arsenide (GaAs) photon-emitting diode, and a Si phototransistor in a single integrated-circuit flat package. The driver circuit delivers bias to the photon-emitting diode and, with DTL circuitry, provides for up to 10 inputs. The emitting diode is optically coupled to the electrically isolated phototransistor which provides the output-switch terminals. Author

N69-16698# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
ACTIVE ACOUSTIC DEVICES Final Report, Jun. 1964-Apr. 1968
Nicholas G. Sakiotis and Fred S. Hickernell Griffiss AFB, N. Y. RADC Nov. 1968 156 p refs
(Contract AF 30(602)-3478)
(AD-679130; RADC-TR-68-352) Avail: CFSTI CSCL 9/1

The report describes efforts to determine the feasibility of continuous wave devices and to demonstrate the capability for performing active electronic functions using electroacoustic phenomena in low noise, power and radio frequency amplifiers within the frequency range 1 MHz to 1000 MHz. Author (TAB)

N69-16732# IIT Research Inst., Chicago, Ill. Technology Center.
FIBER OPTICS WITH EXTENDED ULTRAVIOLET TRANSMISSION Triannual Report No. 3, 1 Mar.-31 Aug. 1968
P. C. Li, M. A. Ali, O. H. Olson, and M. A. Schwartz Nov. 1968 53 p refs
(Contract DAAB07-67-C-0542)
(AD-678490; G6018; ECOM-0542-3) Avail: CFSTI CSCL 9/1

This is the third triannual report describing the research and development leading to fabrication of fiber-optic faceplates for cathode ray tubes with high transmission in the near- and middle-ultraviolet spectral regions. The current program is, primarily, to evaluate existing optical glasses and develop improved ones suitable for meeting specific performance requirements. Formulation studies of new glasses containing La_2O_3, Gd_2O_3, Yb_2O_3, Lu_2O_3 and Rb_2O were continued. Raw materials of different grades were investigated and the effect of such impurities as Co, Ni, Cr, Cu, Sm, and Pr on spectral transmission determined. In addition, density, refractive index, softening point and absorption coefficients were measured. Author (TAB)

N69-16733# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC ELEMENTS OF COMPUTATION TECHNICS (SELECTED ARTICLES)
5 Jan. 1968 20 p refs Transl. into ENGLISH from the Publ. "Magnitnyye Elementy Vychislitel'noy Tekhniki" Moscow, Izd.Vo Nauka, 1966 p 63-67, 100-106
(AD-678795; FTD-MT-24-366-67) Avail: CFSTI CSCL 9/5

CONTENTS:
1. A SET OF HIGH-SPEED CORE-DIODE MODULES G. I. Dmitrakova et al p 1-6 refs (See N69-16734 06-09)
2. THIN FILM MATRIX MEMORY WITH A CONDUCTIVE SUBSTRATE Y. F. Berezhnoy et al refs (See N69-16735 06-09)

N69-16734# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SET OF HIGH-SPEED CORE-DIODE MODULES [KOMPLEKS BYSTRODEYSTBUYUSHCHIKH FERRIT-DIODNYKH MODULEY]

G. I. Dmitrakova et al *In its* Magnetic Elem. of Computation Tech. 5 Jan. 1968 p 1–6 refs (See N69-16733 06-09)
Avail: CFSTI

A set of core-diode logic circuits intended for operation using a clock frequency of 500 kHz is described. The circuits are stable over a wide temperature range because deterioration of interstage diode characteristics is compensated by an additional core winding. These circuits use two-phase power whose generator (a vacuum tube version capable of driving 150 core-pairs) is also illustrated. Standard 0.25 VT cores are used throughout in conjunction with low forward resistance diodes. The forward voltage drop of these diodes is 0.5 V; fanout of each circuit, 3; and nominal pulsed advance current, 300–400 mamp. Average power consumption of each circuit is approximately 0.2 w with a voltage drop across it of 1.4 V. The operating temperature range for the whole circuit time is between −40° and 70°C. Author

N69-16750# Army Electronics Labs., Fort Monmouth, N. J.
DESIGN CONSIDERATIONS FOR CRYSTAL RESONATORS WITH PRESCRIBED MODE SUPPRESSION
G. K. Guttwein, T. J. Lukaszek, and A. D. Ballato Sep. 1968 31 p refs
(AD-678488; ECOM-3018) Avail: CFSTI CSCL 9/1

In virtually all filter crystal applications and in certain specific oscillator crystal applications, such as fixed tuned oscillators, the reduction or elimination of unwanted modes is of paramount importance. It has only recently become apparent, however, that a need also exists for crystal resonator types possessing mode suppression figures intermediate to those usually associated with conventional oscillator crystals, on one hand, with little or no suppression, and filter crystals, on the other, where a maximum suppression is desired. Such intermediate levels are particularly useful inasmuch as a partial relaxation of the mode suppression requirement allows the gamut of achievable values to be extended for the other modal parameters. This report shows how, in order to control the mode spectrum in quartz crystal resonators, the techniques of energy trapping are employed, and how a compromise is effected in such a fashion that unwanted mode suppression can be traded off against crystal resistance and motional capacitance. A procedure is formulated which is general enough to permit the design of crystal resonator types to be made in a straightforward, logical manner with a minimum of assumptions. This procedure is applied to the design of third overtone oscillator units in the range 35 to 60 MHz because the unwanted mode problem appears to be most pronounced with these types. Author (TAB)

N69-16784# Army Electronics Labs., Fort Monmouth, N. J.
A 500-KW X-BAND AIR-COOLED FERRITE LATCHING SWITCH
Richard A. Stern and John P. Agrios Oct. 1968 24 p refs
(AD-679022; ECOM-3031) Avail: CFSTI CSCL 9/1

The design of a high-power air-cooled microwave SPDT switch which is capable of operation at peak and average power levels of 500 kW and 666 W respectively is described. The unit is of a differential phase shift circulator design employing 90 degrees nonreciprocal phase shift elements which are forced air cooled. The phase shifter design employs dual ferrite toroids, floating in reduced height RG-51 waveguide. Two approaches are compared for heat sinking the phase shifter; namely, the H-beam and the I-beam configurations. The results obtained indicate that the I-beam configuration is superior to the H-beam configuration. The switch exhibits an insertion loss of 0.6-dB maximum and isolation greater than 20 dB over a 100-MHz bandwidth centered at 9.375 GHz. The input VSWR of the switch over the frequency band is less than 1.25:1. Author (TAB)

N69-16786*# Auburn Univ., Ala. Electrical Engineering Research Lab.
THE ANALYSIS AND DESIGN OF A CLASS-D AMPLIFIER
M. A. Honnell 26 Feb. 1968 125 p refs
(Contract NAS8-11344)
(NASA-CR-98232) Avail: CFSTI CSCL 09A

Switching-mode, or class-D, amplification may be used to take advantage of the high efficiency of operating transistors in the saturation region. This report describes the theoretical analysis of a basic switching-mode amplifier configuration, and reduces the theoretical material to a specific procedure for the practical design of switching-mode amplifiers for a variety of applications. The basic configuration features high overall efficiency, low quiescent power consumption, a filtered, analog output signal, and adaptability to a wide variety of input, feedback and load configurations. Included is a design example with a maximum d-c power output of 150 watts at an overall efficiency of 90% at maximum power output. Author

N69-16803# General Electric Co., Owensboro, Ky. Tube Dept.
THREE HUNDRED MILLIWATT X-BAND TRIODE OSCILLATOR Final Report, 1 Dec. 1965–30 Apr. 1968
J. M. Connelly and L. F. Jeffrey Nov. 1968 137 p
(Contract DA-28-043-AMC-01795(E))
(AD-679140; ECOM-01795-F) Avail: CFSTI CSCL 9/1

Mechanically tuned triode-in-cavity oscillators covering the frequency range from 8.850 to 9.170 GHz were successfully demonstrated during this program. Highest CW power output obtained was 750 milliwatts with 600 milliwatts a typical value in the final models. The target objective was a minimum output of 300 milliwatts. Electronic tuning by means of varactor diode was not practical in the circuits evaluated because of inadequate tuning range and excessive power output loss. Heat generated by an anode dissipation of 15 watts prevented location of the varactor in the most effective circuit position, such as in close proximity to the grid-to-anode gap, and thereby minimized the effect of capacitance change of the varactor on the frequency. Operational life was generally less than required. Best operational life of 265 hours duration was obtained from a triode having a nickel base cathode and a novel interwoven grid structure. Failure mechanism is an increase in effective Mu because of film formation on grid surfaces and a decline in the required peak cathode emission. Eight triode designs and five cavity designs were evaluated during the program. Author (TAB)

N69-16359*# IIT Research Inst., Chicago, Ill. Technology Center.
DEVELOPMENT OF A CONTINUOUS SCANNING LAMINOGRAPH Final Report, 20 Jun. 1966–30 Jun. 1968
R. B. Moler, ed. Oct. 1968 16 p refs
(Contract NAS8-20640)
(NASA-CR-98249; IITRI-V6034-24) Avail: CFSTI CSCL 09C

The design of a X-ray laminograph for the inspection of multilayered printed wiring boards is presented. The design is based on the use of a closed circuit television system in conjunction with an optical derotation system to form a motionless image. Three magnifications are provided, 0.2X, 1X, and 4X, to allow either coarse or detailed inspection. The X-ray source and television camera may be programmed to scan the sample automatically in depth (Z-axis) and area (X and Y axes). The resolution is limited by the optical system to about 0.001 in. Vertical (layering) resolution is 0.002. Any volume of the sample may be selected for inspection. A manual mode is also available which allows complete operator control of the inspection. Author

N69-16900# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONSTRUCTION OF DIODE FUNCTIONAL CONVERTERS WITHOUT REFERENCE VOLTAGES [POSTROYENIYE DIODYKH FUNKTSIONAL'NYKH PREOBRAZOVATELEY BEZ OPORNYKH]

Ye. I. Lamin *In its* Analog and Analog-Digital Computer Eng. 12 Dec. 1967 p 8–15 refs (See N69-16898 06-08)
Avail: CFSTI

An analysis of the design of nonlinear diode functional converters, without reference voltages, using silicon voltage-reference diodes is presented. The nonlinear units can be made from any ordinary nonlinear diode element circuit. Formulas are derived for calculation of the parameters of the nonlinear unit. The exclusion of reference voltages from the converter circuit eliminates one source of errors and also makes the operating conditions of the dc amplifiers less demanding. The results are presented from tests of a squarer unit for an input voltage range from 0 to 100 V. Two-day tests showed no essential deviation in the reproduction of the curve; the mean square error upon increasing the temperature from 25 to 65°C increases to 1.3%. When a thermoresistor was included in the circuit of the converter the error dropped to 0.18%. Author

N69-16903# Dow Chemical Co., Midland, Mich.
A STUDY OF THE EFFECT OF TIME, TEMPERATURE AND MOISTURE ON BONDED INTERFACES IN 'BONDED JACKET' CABLE CONSTRUCTIONS
H. G. Frank, M. C. McGaugh, and W. E. Ropp 1968 19 p refs
(AD-678825) Avail: CFSTI CSCL 9/1

The test results reported in the paper further substantiate the original cable design concepts using the EAA copolymer. The stability and aging effects of the EAA copolymer and the bonds formed therefrom are most satisfactory for cable applications. In critical areas, the expected useful life of cable incorporating the bonded jacket concepts is undoubtedly extended beyond that expected from conventional constructions without bonding. Author (TAB)

N69-16918# Whitney Blake Co., New Haven, Conn.
SUBMINIATURE AUDIO RETRACTILE CORDS
W. H. Couch, J. C. Wolff, R. H. Dudley, and D. Lichtenstein (Army Electron. Command, Fort Monmouth, N. J.) [1968] 37 p refs Presented at the 17th Intern. Wire and Cable Symp., Atlantic City, 4–6 Dec. 1968
(AD-678824) Avail: CFSTI CSCL 9/1

The USAECOM development project under which this work was conducted resulted in the development of a series of subminiature audio retractile cords approximately one-half the size of miniature cords heretofore available. Cords were made with two, four, five, and seven conductors, with both stranded wire and tinsel conductors and with some legs individually shielded. Author (TAB)

N69-16954*# Stanford Univ., Calif. Radioscience Lab.
CIRCUIT SYNTHESIS UTILIZING DIGITAL VARIABLE-PRECISION-INTEGRATING AND SUMMING ELEMENTS
Chia-peir Yu Dec. 1968 153 p refs
(Grant NGL-05-020-014)
(NASA-CR-73715; SU-SEL-68-084; SR-30) Avail: CFSTI CSCL 09A

In the electrical network, transfer and driving-point functions have, in the past, been designed and implemented by using either passive elements or a combination of active and passive elements. These analog network functions possess such problems as drift, unsteady gain, and temperature sensitivity, causing variations from the desired response. In this report, an alternative digital approach is suggested which could overcome these problems. General-purpose digital computers have been utilized to numerically generate transfer functions using sampled digital data provided by analog-to-digital converters. To permit the implementation of both transfer and driving-point functions, a pair of integrated-circuit digital building blocks are proposed. These are a digital increment integrator module and a digital increment summing module to be used as the building blocks to replace all or the majority of all possible electrical components and networks. Three synthesis methods and their performance errors are presented and compared, from which one procedure is deduced to yield a network function with a minimum number of modules as well as best performance. Author

N69-17012# Harry Diamond Labs., Washington, D. C.
MEASURING EXCESS NOISE AT 2.3 GHz
Walter F. Straub Aug. 1968 23 p
(AD-679019; HDL-TR-1378) Avail: CFSTI CSCL 14/2

Excess noise is random perturbations added by an amplifier to the signal generated by an oscillator. A method to measure this noise is described, and the system is used to evaluate the noise performance of an electrostatically focused klystron amplifier at 2.3 GHz. The system sensitivity is -148 dB in a 1-Hz bandwidth at 100 Hz, -168 dB at 1 kHz, and -163 dB at 50 kHz for a 70-mW carrier. At 50 kHz the FM noise of the saturated amplifier is -153 dB 91-Hz BW) and the AM noise is -160 dB. Mechanical resonances of the tube were investigated and a 28-dB noise figure was determined. Author (TAB)

N69-17022# Colorado Univ., Boulder. Dept. of Electrical Engineering.
ELECTRON BEAM NOISE REDUCTION THROUGH OPERATION NEAR LIMITING PERVEANCE Final Technical Report
John C. Twombly and James A. Valent Aug. 1968 77 p refs
(Contract Nonr-1147(06))
(AD-679193; TR-6) Avail: CFSTI CSCL 9/1

The derivative of stored beam energy with respect to perveance increases without limit as perveance approaches the critical or limiting value. The possibility of using this phenomenon for noise smoothing is here investigated by computer simulation of such behavior in a model of an infinite planar triode. The effect on both induced anode current and power arriving at the anode are examined. Little effect is noted on injected charge velocity fluctuations, but a marked reduction of injection current fluctuation power is observed. Improvement of over 3db compared with the low-perveance case occurs over a large percentage bandwidth centered approximately on the space-charge-free transit frequency. Author (TAB)

N69-17055# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
AEROSPACE SYSTEMS AND TECHNOLOGY
In its [Mod. Technol.] Jun. 1968 p 105–117 (See N69-17051 06–11)
Avail: Issuing Activity

In the exploratory development of advanced radar techniques, work was concentrated in three major areas: (1) demonstration of a novel real-time radar signal correlation technique, (2) research aimed at development of a wideband signal recorder and display using light-sensitive thermoplastic film, and (3) investigation of problems related to use of fine-resolution radar to improve navigation accuracy of high-performance aircraft. On-board spacecraft experiments are being devised to measure the electromagnetic scattering coefficient of planetary surface areas through the use of microwave radar techniques. These techniques are of particular interest for the surface of Venus. Also reported are the development of new circuit configurations and techniques applicable to space electronic systems, and studies on the structural and electrical transport properties of evaporated gallium arsenide thin films. M.G.J.

N69-17096 National Lending Library for Science and Technology, Boston Spa (England).
FILM DIODES IN THE BASIS OF CHALCOGENIDE GLASSES
V. I. Ganan et al [1968] 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 9, 1967 p 80-85
(NLL-EE-TRANS-1814) Avail: Natl. Lending Library, Boston Spa, Engl.

The results of the investigation of the volt-ampere characteristics of the metal-dielectric-metal systems, one of the electrodes of which reacts with the dielectric, are presented. The conductivity in these systems in unipolar. It is shown that a space-charge-limited current passes through the system in the forward direction; the reverse current is controlled by Schotty effect. The disadvantage of these diodes is their comparatively narrow operation range. When the temperature is reduced below 245° K, the volt-ampere characteristics become unstable, and rapid changes in current and voltage are observed. The great time lag of the structures does not enable them to be used for current rectification, but they can be used as nonlinear resistivities. Author

N69-17128# California Univ., Livermore. Lawrence Radiation Lab.
DESIGN PRACTICES FOR EMP PROTECTION OF MILITARY SYSTEMS
L. F. Wouters 10 Apr. 1968 45 p refs Presented at Tech. Coop. Program Panel N-4 Meeting, London, 3 Apr. 1968 Supported in part by DASA and AEC
(UCRL-71024-Rev-1; CONF-71024-1) Avail: CFSTI

A form of engineering analysis is discussed for practical electromagnetic protection of hardware in nuclear testing where the following conditions may exist: EM fields as high as 10^5 V/m and 100 G; rise times of 10^{-8} sec; frequency components up to 100 MHz; very low sensitivity components around 10 kHz; and electrical noise effects. System aspects, circuit layout, shielding, grounding, cabling, protective devices and techniques, and component susceptibility are considered. Engineering practice rules are given in an appendix for leakage, apertures, and penetrations in the design of the system; circuit layout; shielding; cabling; grounding; and protective devices and methods. NSA

N69-17146# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
INCREASE OF INTERNAL FIELD EMISSION CURRENT IN SILICON ZENER DIODES UNDER IRRADIATION WITH REACTOR NEUTRONS [VERGROBERUNG DES TUNNELSTROMES IN SLLIZIUM-ZENER-DIODEN BEI EINER BESTRAHLUNG MIT REAKTOR-NEUTRONEN]
H. G. Wagemann, and K. Zander Aug. 1968 31 p refs In GERMAN; ENGLISH summary
(HMI-B-71; BEW-14) Avail: CFSTI

Current-voltage-characteristics of silicon zener diodes of different zener voltages are analyzed for different states of irradiation (neutrons of BER reactor) by means of their temperature coefficient $c+c^{-}0$ leads to the conclusion of prevailing internal field emission. A simple model attributes the increase of leakage current for constant reverse voltage to the density of neutron induced displacements within the energy gap, which allow an additional current due to internal field emission. This model is examined by evaluating the decreasing minority carrier lifetime, the reciprocal value of which behaves in a similar way as the increasing leakage current. The minority carrier radiation damage constants k are calculated, their average amount is $k=2 \cdot 10^{6}$ s 1 cm^2. Author (NSA)

N69-17147# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
INVESTIGATIONS OF THE CHANGE OF THE ELECTRICAL PROPERTIES OF CERAMIC THICK FILM CIRCUITS (SCREEN PRINTED) UNDER THE INFLUENCE OF 1.5 MeV ELECTRON AND GAMMA IRRADIATION (Co^{60} 4000 Ci) [UNTERSUCHUNG DER ANDERUNG DER ELEKTRISCHEN KENNGROBEN VON KERAMIK-SIEBDRUCK-BAUSTEINEN UNTER DER WIRKUNG VON 1.5 MEV-ELEKTRONEN UND GAMMA-STRAHLUNG EINER 4000 CI-CO-60-QUELLE]
H. G. Wagemann Aug. 1968 35 p refs In GERMAN; ENGLISH summary
(HMI-B-72; BEW-15) Avail: CFSTI

Five different types of ceramic thick film circuits (screen printed) of industrial origin were irradiated, gradually up to doses of 10^{16} cm^{-2} 1.5 MeV-electrons and 10^{8}R ^{60}Co γ-rays. Resistors, capacitors (produced in different techniques), diodes, and transistors were investigated concerning their irradiation resistivity. Resistors showed a threshold dose for decreasing ohmic resistance. Capacitors and diodes proved very stable regarding irradiation experiments. Transistors showed a well understood course of damage. Author (NSA)

N69-17148# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
INVESTIGATIONS OF THE ELECTRICAL PROPERTIES OF MNS-TRANSISTORS, PRODUCED IN THE U.S., UNDER INFLUENCE OF GAMMA-IRRADIATION OF Co^{60} (4000Ci) NUCLEAR-REACTOR NEUTRONS (RESEARCH REACTOR BER), AND 1.5 MeV ELECTRONS [UNTERSUCHUNG DER ELEKTRISCHEN KENNGROBEN VON MNS-TRANSISTOREN AMERIKANISCHER HERKUNFTUNTER DER WIRKUNG VON GAMMA-STRAHLUNG EINER 4000 CI-CO 60-QUELLE UND 1.5 MEV-ELEKTRONEN]
H. G. Wagemann and K. Zander [1968] 21 p refs In GERMAN; ENGLISH summary
(HMI-B-70; BEW-13) Avail: CFSTI

Measurements of transconductance, capacitance and recombination currents of irradiated devices lead to the conclusions, that ionizing γ-irradiation shifts the turn-on voltage according to a buildup of positive space charge in the insulating layer and diminishes the transconductance. As a function of γ-irradiation flux and bias during irradiations the changes of these quantities tend to saturate. Author (NSA)

N69-17182# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
OPERATING CHARACTERISTICS OF A DEVELOPMENTAL MODEL PORTABLE NEUTRON GENERATOR
J. C. Roubik and V. C. Thompson 11 Sep. 1968 31 p
(Contract AT(29-2)-656)
(GEPP-43; R-68-ND-20) Avail: CFSTI

This report evaluates the operating characteristics of a developmental model portable neutron generator. The average coefficient of variation is 1.15 percent for 60 out of 64 factor combinations, which means that the generator can be used as a correlation device. The generator requires approximately 30 minutes for output to stabilize under ambient temperature conditions of approximately 20°C. On an average, the output level of the generator is resettable to within −2.3 to −5.4 percent depending on the variable reset. If the required accuracy is no greater than this percentage range, the generator can be used as an equipment calibrator. A neutron output versus control setting calibration curve for the particular Controlatron used in this evaluation is also provided. Author (NSA)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N69-16107*# Texas Univ., Austin. Dept. of Electrical Engineering.
OPTIMAL CONTROL OF LINEAR TIME DELAY SYSTEMS
D. H. Eller, J. K. Aggarwal, and H. T. Banks (Brown Univ.) [1968] 37 p refs Prepared in cooperation with Brown Univ., Providence, R. I.
(Contract NAS8-18120; Grants NGR-40-002-015; AF-AFOSR-766-67; AF-AFOSR-693-67; NSF GK-1879 et al)
(NASA-CR-99232) Avail: CFSTI CSCL 12A

A method is presented by which an optimal control may be obtained for a linear time varying system with time delay. The performance criterion is quadratic with a fixed finite upper limit. The results are a set of partial differential equations with boundary conditions, whose solution yields an optimal feedback control. The discussion includes possible methods for the solution of the partial differential equations. F.S.

N69-16117 Michigan Univ., Ann Arbor.
EXISTENCE ANALYSIS FOR OPTIMAL CONTROL PROBLEMS WITH EXCEPTIONAL SETS
J. R. La Palm (Ph.D. Thesis) 1967 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-7653

The purpose of this thesis is to prove by direct methods existence theorems for optimal solutions of optimal control and the calculus of variations. Indeed in each existence theorem we prove the existence of at least one element, in any given nonempty complete class Ω of admissible elements, which minimizes a given cost functional. Dissert. Abstr.

N69-16198*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS AND DESIGN OF INDUCTORS FOR PROTECTING POWER TRANSISTORS AGAINST CURRENT SURGES IN INVERTER BRIDGE CIRCUITS
Francis Gourash Washington Jan. 1969 46 p refs
(NASA-TN-D-4995) Avail: CFSTI CSCL 09A

An analysis of transistor inverter and converter bridge circuits shows that surge currents exist during the switching time interval. These currents result from transistor unequal turnon and turnoff switching characteristics. The surge currents are limited only by the resistance of the power source and the saturated resistance of the transistors. They can reach peak values which exceed the transistor's maximum current rating by an order of magnitude. Inductors avoid transistor failure by limiting the current surges to safe levels. They also substantially reduce the circuit power loss due to the surge currents. A technique for the design of inductors with the proper inductance is presented. Author

N69-16282# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUCLEAR RESONANCE GENERATOR WITH DYNAMIC POLARIZATION OF NUCLEI IN THE MAGNETIC FIELD OF THE EARTH
A. A. Morozov *In its* Nucl. Magnetic Resonance (Selected Articles) 12 Oct. 1967 p 12-18 refs (See N69-16279 06-06)
Avail: CFSTI

The operation of a nuclear resonance generator which incorporates dynamic polarization of nuclei produced by the Overhauser effect is analyzed. Formulas are given for calculating the resonant frequency and Q of the tank circuit to produce sustained nuclear precession. Deviations from this resonant frequency must be controlled to prevent field measurement errors due to pulling of the generation frequency by the receiving circuit. It is shown that the Q of the tank circuit is determined by the range of magnetic fields measured without returning the circuit and by the error due to pulling of the generator frequency. In order to increase the range of fields which may be measured and reduce pulling, a nuclear resonance generator may be used in which high Q tank circuits are not required for excitation of oscillations. Author

N69-16387# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE USE OF ELECTRONIC DIGITAL COMPUTING MACHINES TO ANALYZE THE STABILITY OF COMPLICATED ENERGY SYSTEMS
V. F. Kurov 5 Jan. 1968 14 p Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR (Novosibirsk), v. 2, no. 1, 1966 p 3-11
(AD-678767; FTD-HT-23-888-67) Avail: CFSTI CSCL 21/1

The possible methods of constructing regions of stability of a linear automatic-control system in the space of the control parameters by using electronic digital computing machines and also methods for obtaining the coefficients of the characteristic equation are considered. The methods of constructing regions of stability that are considered in the article are based on application of algebraic criteria for stability. The use of Newtons interpolation method is extremely convenient when one is programming an electronic digital computing machine since it makes it possible to use the standard programs of linear algebra. This method also compares favorably with the other methods by making fewer demands on the memory of the machine at the cost of a row-by-row formation of the matrix of the transformation. TAB

N69-16398 Iowa Univ., Iowa City.
A STUDY OF STANDARD ASSIGNMENTS FOR ASYNCHRONOUS SWITCHING CIRCUITS
Pao-Tsin Wang (Ph.D. Thesis) 1968 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-10703

Standard assignments for asynchronous switching circuits are studied. A standard assignment is one which works for any asynchronous machine, regardless of the structure of the machine. Since, in general, standard assignments require more circuit components, minimum time transitions between any two states of an asynchronous machine are emphasized in deriving an assignment. To achieve this goal, a class of linear error correcting codes is used as assignments for asynchronous machines. This class of codes is, in nature, a class of equidistant codes. A tight upper bound on the number of variables required to realize asynchronous machines with delay elements is derived. Also derived is an upper bound on the number of variables required to realize asynchronous machines without delay elements. Reduction techniques are introduced to eliminate unnecessary variables for specific flow tables. In order to facilitate the integrated fabrication of physical circuits, a relatively simple logic for realizing asynchronous machines is suggested. Dissert. Abstr.

N69-16441 Washington Univ., St. Louis, Mo.
SOME OPTIMAL-CONTROL PROBLEMS IN DISTRIBUTED-PARAMETER SYSTEMS
Manthri S. Narasimha (Ph.D. Thesis) 1968 177 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-10797

The analytical design of the optimal regulator is worked out in detail for linear time-invariant distributed systems, deriving the necessary conditions of optimality by using calculus of variations. Two methods are suggested to solve the boundary value problems arising from the regulator problem for linear time-invariant systems. As a further application of the principles involved in the analytical design, the optimal control of a fluid interface is discussed. Optimal control of distributed systems with constraints on the control functions is studied. Functions analogous to the Hamiltonian of lumped-parameter systems are defined on the distributed field and on its boundary. Their relations on the boundary are also obtained. A necessary condition for optimality is enunciated as a maximum principle, and a non-rigorous proof is presented. The situations when the maximum principle gives both necessary and sufficient conditions for optimality, are indicated. Dissert. Abstr.

N69-16523# Forsvarets Forskningsanstalt, Stockholm (Sweden).
SYSTEMS ANALYSIS BY ADJOINT METHOD [SYSTEMANALYS MEDELST ADJUNGERING]
Torgny Schuett Jul. 1967 25 p refs In SWEDISH
(A-2488-50) Avail: CFSTI

The application of superposition in analyzing linear time-variable dynamic systems is reviewed. Starting with the definition of a linear dynamic system, the matrix method is used to determine the characteristics of signal transmission systems. Deterministic and stochastic input signals and a time-invariant system are also treated. K.W.

N69-16530 Wisconsin Univ., Madison.
ANALYSIS OF A NEW METHOD FOR DECREASING ARC EXTINCTION TIME REQUIRED FOR SINGLE POLE RECLOSING IN EHV SYSTEMS
Narayan Vishwanath Dravid (Ph.D. Thesis) 1968 180 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-7095

Single pole reclosing is an important means of improving the transient stability of a power system, because of the preponderance of nonpermanent, single line to ground faults. However, it has a drawback of requiring a longer arc deionization time relative to the alternative of three pole reclosing, thereby offsetting some of the improvement in transient stability. This requirement of longer arc deionization is caused by the capacitive coupling of the faulted conductor from the other two energized conductors which tends to sustain current in the original fault arc path. A new method for nullifying the capacitive coupling of the faulted phase is analyzed, mainly as a steady state problem. The new method requires the addition of a capacitor, connected across the terminals of each breaker pole involved in single pole reclosing. The effectiveness is studied as a function of the representative magnitudes of various system parameters: line length, line constants, line loading, source characteristics and series compensation for longer lines. Solution of the problem is based on the analysis of a circuit which is constructed for each given situation. Two-Port Network Theory (ABCD constants) is principally employed in this connection. This resulted in computer programs which were made up of a set of basic subroutines. Dissert. Abstr.

N69-16561 IIT Research Inst., Chicago, Ill.
OPTIMAL CONTROL OF DISTRIBUTED PARAMETER SYSTEMS BY USING FUNCTIONAL ANALYSIS
William Adam Weigand (Ph.D. Thesis) 1968 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-7783

The optimal open loop control of systems described by a set of linear partial differential equations is investigated. The performance index is of quadratic type and the mean square error is considered as a special case. Energy type inequality constraints are imposed on the control inputs. The problem is formulated as a minimization problem in Hilbert space. The necessary and sufficient condition for a minimum are obtained, and it is proved that these conditions yield the global minimum. It is shown how the solution to the constrained problem can be obtained from the solution of the unconstrained problem. The optimal control functions satisfy Fredholm integral equations with symmetric kernels. Techniques for the solution of such equations are discussed. Dissert. Abstr.

N69-16765 Purdue Univ., Lafayette, Ind.
THE RELATIONSHIP OF MAGNETIC MATERIAL PROPERTIES TO THE OPERATION OF A MAGNETIC SENSE AMPLIFIER DEVICE
James Robert Eston, Jr. (Ph.D. Thesis) 1967 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-8652

A mathematical model is developed which relates the properties of the magnetic materials to the device operation. The magnetic materials utilized are square-loop ferromagnetic materials in the form of toroidal cores. The development of the model is based upon the observed behavior of the magnetic material during device operation. The magnetic sense amplifier device is capable of the detection of a small signal current which occurs at a known instant in time. By means of capacitor current feedback during cyclic excursions of the B-H loop, a voltage on an output winding can be made to "build up" in a parametron-like manner. The output voltage, after a known time delay, is of the same polarity as the original signal current, but has significantly greater voltage than that due to the signal current. Dissert. Abstr.

N69-16810*# Illinois Univ., Urbana. Biological Computer Lab.
A NEW HOMEOSTAT
Michael G. Wilkins 15 Jun. 1968 28 p refs
(Grant NGR-14-005-111; Contract AF-33(615)-3890; Grant AF-AFOSR-7-67)
(NASA-CR-73655; BCL-8.3) Avail: CFSTI

The concept of homeostasis and its relations to control and regulation is briefly discussed,and the ideas leading to the concept of the ultrastable hierarchic controller are sketched. Previous electronic realizations of homeostatic controllers are discussed, and a new homeostat is described briefly. The machine, under construction, has a number of new and useful features and these are described, together with experiments to be performed when the machine is complete. Author

N69-16857* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
MINIMAL TIME CONTROL OF LINEAR SYSTEMS WITH CONTROL AMPLITUDE AND RATE SATURATIONS
J. Y. S. Luh and J. S. Shafran Dec. 1968 260 p refs
(Contracts NAS7-100; N0014-67-A-0226)
(NASA-CR-73657; TR-EE-68-33) Avail: CFSTI CSCL 09C

Consideration is given to three aspects of the minimal time control problem for a class of linear systems, characterized by constraints on both the control amplitude and rate. The first problem is the minimal time open-loop control of linear time-varying processes. Based on the Maximum principle, necessary conditions are developed for a specific modified adjoint solution. Two additional conditions associated with this modified adjoint solution are also derived, and are then used to develop a systematic procedure of constructing the extremal controls. The results are presented in six tables consisting of groups of inequalities used to determine the unknown parameters of the extremal controls. These inequalities are also incorporated into a digital computer program. The second problem is the development of a sub-optimal closed-loop solution. This method is based on obtaining a parameterized approximation to be isochrones of the given system. The last aspect involves the problem of recoverability. Necessary and sufficient conditions provide a test criterion that determines whether the entire state space is recoverable. Author

N69-16863# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
THE JOINT SERVICES TECHNICAL ADVISORY COMMITTEE Progress Report, 15 Sep. 1967–14 Sep. 1968
Arthur A. Oliner and Jerome Fox Nov. 1968 410 p refs
(Contract AF 49(638)-1402)
(AD-679135; PIBMRI-R-452.33-68; AFOSR-68-2163; PR-33)
Avail: CFSTI CSCL 20/14

This report is the thirty-third in a series of progress reports to the Joint Services Technical Advisory Committee since inception of the Joint Services Electronics Program at the Polytechnic Institute

of Brooklyn in July 1955. The report, now being issued annually, summarizes research accomplished under the aegis of the Microwave Research Institute and reflects the impact of the Joint Services Electronics Program on the research activities of faculty and students of the participating departments of the Institute. The program covers a broad spectrum ranging from basic theoretical physics, mathematics, and engineering, to experimental investigations involving basic measurements, development of devices, and materials. Each activity reports in summary fashion on specific results obtained during the report period of 15 September 1967 through 14 September 1968 with individual acknowledgment of the sponsorship which has contributed to the reported work. The report is compiled under seven headings: Electromagnetics and Waveguide Techniques; Quantum Electronics and Optics; Plasma Physics and Electronics; Solid State and Materials; Control Theory and Computer Science; Communications and Information Processing; Networks and Systems. Author (TAB)

N69-16913# Pennsylvania Research Associates, Inc., Philadelphia.
SELF-REPAIR THEORY INVESTIGATION Quarterly Report, 1 Jan.–31 Mar. 1968
Edward W. Veitch and David C. Roberts Sep. 1968 34 p refs
(Contract DA-28-043-AMC-02344(E))
(AD-678489; 668-1142; ECOM-02344-7; QR-7) Avail: CFSTI CSCL 9/5

This is the seventh report from a study to develop a theory of self-repair in digital nets via fault diagnosis and automatic circuit replacement using the Sequential Prime Implicant Form for net representation as an analytical tool in net failure detection and diagnosis. This report discusses an improvement to the computer program being developed to implement the SPIF algorithm. It also discusses some new aspects of the SPIF covering use of nonresolved projections and concerning synthesis of redundancy. Author (TAB)

N69-16970# California Univ., Berkeley. Dept. of Electrical Engineering.
STUDIES OF A THEORY FOR NETWORK DESIGN Final Report, 1 Nov. 1966–15 Sep. 1968
R. A. Rohrer Nov. 1968 7 p refs
(Grant AF-AFOSR-1219-67)
(AD-678609; AFOSR-68-2610) Avail: CFSTI CSCL 9/5

The original intent of the investigation was to bring to bear upon electronic circuit design problems those powerful mathematical optimization techniques which could be implemented on digital computers. That this goal was overwhelmingly realized is both a great satisfaction as well as a profound stimulus to further research. A simple network theoretic interpretation of the necessary conditions of mathematical optimization in terms of an adjoint model has facilitated computations in terms of existing network analysis programs. In all phases of the study two major problems have consistently recurred: (1) The enunciation of electronic circuit design goals in terms of a functional to which mathematical optimization applies; and (2) the necessity to employ gradient information effectively and economically. Author (TAB)

N69-17051# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
[MODERN TECHNOLOGY] Annual Report, 1 Jul. 1967–30 Jun. 1968
Jun. 1968 123 p refs
Avail: Issuing Activity

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1. CONTROL STUDIES AND DYNAMIC SYSTEMS p 1–25 (See N69-17052 06-10)
2. COMPUTER APPLICATIONS p 27–67 (See N69-17053 06-08)
3. COMPUTER TECHNOLOGY AND INFORMATION DISPLAY p 69–104 (See N69-17054 06-08)
4. AEROSPACE SYSTEMS AND TECHNOLOGY p 105–117 (See N69-17055 06-09)
5. PUBLICATIONS p 119–126 refs

N69-17052# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
CONTROL STUDIES AND DYNAMIC SYSTEMS
In its [Mod. Technol.] Jun. 1968 p 1–25 (See N69-17051 06-10)
Avail: Issuing Activity

Summary data are presented on the research projects pertaining to control studies and dynamic systems. The scope of nonlinear systems stability was expanded to include infinite dimensional systems and systems in which the state space is not an Euclidean space but has a more complex structure. Several aspects of deterministic and stochastic optimal control theory were assessed in relation to aerospace transportation, and power systems applications. Process control efforts were concentrated in the areas of reactor stability, optimal control and model control of discrete and continuous systems, and estimation of the state of continuous systems. In seeking solutions to problems pertaining to the guidance and control of modern, high speed, underwater vehicles, consideration was given to the application and extension of control, communication, and detection theory; the design and evaluation of human operator and autonomous control systems; the design and evaluation of the use of real-time digital and analog computing and display equipment; and the design of servomechanism components. In support of the M.I.T. Highway Transportation program, reviews were conducted on the state-of-the-art in vehicle simulation and modeling, and the status of highway safety research. M.G.J.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N69-16171# Stanford Univ., Calif. High Energy Physics Lab.
RF AMPLITUDE AND PHASE STABILIZATION FOR A SUPERCONDUCTING LINEAR ACCELERATOR BY FEEDBACK STABILIZATION TECHNIQUES
Larry R. Suelzle Jun. 1968 23 p refs
(Contract Nonr-225(67))
(AD-678717; HEPL-564) Avail: CFSTI CSCL 20/7

The paper describes some of the feedback stabilization techniques being examined and tested at Stanford and to describe how the high-Q characteristic of a superconducting linac can simplify some of the feedback control problems. Author (TAB)

N69-16186# Stanford Univ., Calif. High Energy Physics Lab.
PARTICLE MOTION IN A STANDING WAVE LINEAR ACCELERATOR
E. E. Chambers Jul. 1968 41 p
(Contract Nonr-225(67))
(AD-678718; HEPL-570) Avail: CFSTI CSCL 20/7

The paper is a mathematical treatment of particle motion in a linear accelerator for both the traveling wave and standing wave accelerators. Low energy, high energy, and relativistic particles are included. TAB

N69-16306 National Lending Library for Science and Technology, Boston Spa (England).
EXPERIENCE IN THE CONSTRUCTION OF AIRPORT CONTROL APPARATUS [OPYT KHUDOZHESTVENNOGO KONSTRUIROVANIYA DISPETCHERSKOI APPARATURY DLYA AEROPORTOV]
V. Pompushkin et al. Sep. 1968 10 p Transl. into ENGLISH from Tekhn. Skaya Estetika (USSR), no. 12, 1964 p 2-4
(NLL-RTS-3105) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d

The construction of a new type of indicator apparatus and control panel, which correspond to revised psychological, operational, and aesthetic specifications, is described. The control panel section consists of a framework construction plated with sheet iron, inside of which the functional units are installed. The indicator housing includes removable walls with a grating to allow self cooling of indicator elements. The front cover of the indicator is also removable and has a visor to protect the screen of the electron beam tube from direct exposure to external rays of light. Attention was paid to the color of the controls so as not to distract the operator's attention and to allow clear reading against the background of the cover. Color considerations were also important in the design of the overall exterior. The arrangement of the components and the operation of the equipment are described. A.C.R.

N69-16365# Stanford Univ., Calif. High Energy Physics Lab.
THE DEVELOPMENT OF LOW TEMPERATURE TECHNOLOGY AT STANFORD AND ITS RELEVANCE TO HIGH ENERGY PHYSICS
H. Alan Schwettman Aug. 1968 26 p refs Presented at the Summer Study on Superconducting Devices and Accelerators, Upton, N. Y., 1968
(Contract Nonr-225(67))
(AD-678721; SU-HEPL-578) Avail: CFSTI CSCL 20/7

The High Energy Physics Laboratory at Stanford University is developing the superconducting linear accelerator and the related low temperature technology. This report gives technological innovations resulting from the research, and also a few applications to high energy physics. TAB

N69-16445 European Organization for Nuclear Research, Geneva (Switzerland).
INTENSITY DEPENDENT EFFECTS AND SPACE CHARGE LIMIT INVESTIGATIONS ON CERN LINEAR INJECTOR AND SYNCHROTRON
P. M. Lapostolle, C. S. Taylor, P. Tetu, and L. Thorndahl 12 Oct. 1968 78 p refs
(CERN-68-35) Avail: CFSTI

Experimental work on space charge effects at CERN on the PS and its linac injector was started in 1967 in an attempt to confirm theoretical intensity limits. Various unexpected effects have been observed which require more accurate experimental investigation and perhaps more development of the various theoretical approaches at present under way to explain them. Author

N69-16603# Forsvarets Forskningsanstalt, Stockholm (Sweden).
HELIUM RECOVERY SYSTEMS [ATERVINNINGSANLAEGGNING FOER HELIUM]
G. Florin Sep. 1967 14 p In SWEDISH
(FOA-2-C 2189-51) Avail: CFSTI

A simple helium recovery system is described whose design provides for varying requirements in capacity, degree of automation, and desired purity of the gas. This system is suitable for recovery in small facilities, such as miniature refrigerator systems for cooling electronic components. Author

N69-16689# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE DEEP SPACE NETWORK: SPACE PROGRAMS SUMMARY, VOLUME 2
30 Sep. 1968 126 p refs
(Contract NAS7-100)
(NASA-CR-99218; JPL-SPS-37-53-Vol-2) Avail: CFSTI CSCL 22D

Technical activities of the Deep Space Network (DSN) are reported in the areas of the research and development conducted in support of future flight projects, the implementation of demonstrated capabilities for support of the more immediate flight projects, and the direct support provided for currently active missions. The subjects covered include mission support for interplanetary flights, planetary flights, and manned space flights; tracking and navigational accuracy analysis, communications system, and tracking and data acquisition elements; network development and operations; the Space Flight Operations Facility, the Ground Communications Facility, and the Deep Space Instrumentation Facility; and the design and implementation of technical structures and utilities. Overall system operation of the DSN is described. M.G.J.

N69-16758# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
MEASUREMENT OF GAS VELOCITY IN A PLASMA WIND TUNNEL USING AN ELECTRON BEAM PROBE
Charles Cason Jul. 1968 19 p refs
(AD-678494; RR-TR-68-4) Avail: CFSTI CSCL 14/2

An electron beam probe was installed in a 8000-kilowatt plasma facility. Difficulty in applying the electron beam probe to measurements of gas density, etc., was found to be due to the weak plasma arc generated magnetic fields producing positional displacements of the beam. These problems were solved by means of a closed-loop electronic controller. Response time of the controller is down 3 decibels at 130 hertz which was found to be sufficiently fast for adequate control. Attempts to measure gas velocity by measuring drift rates of beam generated plasma cylinders at fixed rates uncovered other problems. Estimates of gas velocity by this method gave 3700 plus or minus 400 meters per second as compared to a machine computed value of 3800 meters per second for air of h/RT sub o = 150. Author (TAB)

N69-16790# Union Carbide Corp., Tonawanda, N. Y. Linde Div.
DEVELOPMENT OF A TURBOCOMPRESSOR GAS BEARING SIMULATOR Final Report
S. V. Lukas Oct. 1968 110 p refs
(Contract NAS3-10927)
(NASA-CR-72479) Avail: CFSTI CSCL 14B

Design details and test data are presented on a gas bearing simulator for a Brayton cycle radial flow turbocompressor. The gas bearing system consists of two cylindrical journal bearings supported on damped, flexible supports and a double-acting spiral-grooved thrust bearing. The stability of the journal bearings in the horizontal and vertical positions was investigated experimentally. Author

N69-16950# TRW Systems Group, Redondo Beach, Calif.
FAST RESPONSE SOLAR ARRAY SIMULATOR Final Report, 25 Jun. 25 Oct. 1968

25 Oct 1968 63 p refs
(Contract NAS5-11581)
(NASA-CR-73712) Avail: CFSTI CSCL 14B

Tradeoff studies were performed to determine the design requirements for a fast response solar array simulator capable of delivering output power in the range of 20 to 5000 watts. Evaluation of the tradeoff studies led to the selection of a reference design that includes the following features: Generation of the static and dynamic characteristics of the solar array through the use of a forward biased solar cell as an analog reference; Programming of these characteristics for variation in illumination and temperature with time by digital techniques; A 500w module as the basic building block for a 5000w system; Current accuracy of 0.5% of the short circuit current setting. Author

N69-16961# Federal Aviation Agency, Atlantic City, N. J. National Aviation Facilities Experiment Center.
FRICTION EFFECTS OF RUNWAY GROOVES, RUNWAY 18-36 WASHINGTON NATIONAL AIRPORT Final Report
William A. Hiering and Charles R. Grisel Dec. 1968 86 p refs
(AD-678645; NA-68-31; DS-68-21) Avail: CFSTI CSCL 1/5

Wet and dry runway friction tests were conducted on bituminous concrete Runway 18-36 at Washington National Airport using a Fixed Slip Runway Friction Tester. These tests were conducted to determine if significant friction changes were generated as a result of grooving the runway surface with 1/8- by 1/8-inch-transverse grooves spaced on 1-inch centers. Data analysis indicates that at test speeds of 10 to 60 mph, no appreciable increase or decrease in overall runway friction values was obtained for this series of tests. The treatment of the runway surface, however, by the cutting of uniformly spaced grooves markedly smoothed the resultant wet runway friction values. It is hypothesized that these smoother wet runway friction values result in a surface that affords more efficient operation of aircraft antiskid braking devices and more effective manual braking. Author (TAB)

N69-17028*# International Information Inc., Philadelphia, Pa.
MHD-ACCELERATOR FOR REENTRY SIMULATION STUDIES [MHD-BESCHLEUNIGER ZUM STUDIUM DER SIMULATION DES WIEDEREINTRITTS]
F. Lindner et al Washington NASA Jan. 1969 25 p refs Transl. into ENGLISH from German Presented at the Roy. Aeron. Soc. Centenary 5th Congr. of the Intern. Council of the Aeron. Sci., London, 12-16 Sep. 1966
(Contract NASw-1499)
(NASA-TT-F-10671) Avail: CFSTI CSCL 14B

A number of unsolved physical and technological problems are involved in the reentry of a space vehicle into the terrestrial atmosphere. Since there are no suitable hypersonic wind tunnels, it is very difficult to conduct investigations in this field. There were several suggestions in recent times for the generation of the high gas velocities required for the reentry simulation by means of MHD-accelerators. In this project, the conditions which reentry simulators must fulfill were investigated on the basis of the physical parameters prevailing in the upper stratosphere and the trajectories of ballistic space vehicles. Then, the means of operation of various types of MHD-accelerators were discussed and their use in simulation installations described. It was shown that it is possible to simulate the entire reentry process with the aid of MHD-accelerators. Author

N69-17041# Los Alamos Scientific Lab., N. Mex.
FIRST LAMPF USERS' MEETING
C. Robert Emigh, ed. and Katherine H. Harper, ed. Sep. 1968 83 p refs Proc. of Conf. held at Los Alamos, N. Mex., 20 Jun. 1968
(Contract W-7405-Eng-36)
(LA-3963-MS) Avail: CFSTI

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N69-17042# Los Alamos Scientific Lab., N. Mex.
PLANNED MANAGEMENT OF THE FACILITY AND ITS RELATION TO PARTICIPATING USERS' GROUPS
Louis Rosen *In its* 1st LAMPF Users' Meeting Sep. 1968 p 3-10 (See N69-17041 06-11)
Avail: CFSTI

A progress report is presented on the technical and budgetary status of the Los Alamos Meson Physics Facility (LAMPF) and its administration as a national research installation. The development and construction of the linear accelerator is emphasized.

N69-17043# Brookhaven National Lab., Upton, N. Y.
A REVIEW AND DISCUSSION OF THE STRUCTURE OF USERS' ORGANIZATIONS
R. Ronald Rau *In* Los Alamos Sci. Lab. 1st LAMPF Users' Meeting Sep. 1968 p 11-17 (See N69-17041 06-11)
Avail: CFSTI

The user organizations at several national research installations, including Argonne and Brookhaven National Laboratories, are discussed as background for the establishment of such a program at the Los Alamos Meson Physics Facility. Formal and informal organizations are contrasted, with emphasis on the need for a formal structure in order for users to obtain maximum information about the facility, its programs and plans, and to provide a means of requesting help in individual or group situations. A.C.R.

N69-17045# Los Alamos Scientific Lab., N. Mex.
PROPOSED EXPERIMENTS AND EXPERIMENTAL FACILITIES AT LAMPF MUON EXPERIMENTS
Vernon Hughes *In its* 1st LAMPF Users' Meeting Sep. 1968 p 23-27 refs (See N69-17041 06-11)
Avail: CFSTI

The improved capabilities for muon research available at the newly established Los Alamos Meson Physics Facility are described, and suggestions are made for possible experiments using these capabilities. With a factor of 10^4 increase in beam intensity, vastly improved and entirely new research efforts can be considered. This increase in meson beam intensity comes from a 10^3 increase in the time average primary proton beam and from another factor of 10 from the availability of an external proton beam. The duty cycle is to be either 6 or 12 percent. The formula

for the muon beam intensity at the output of a muon channel and various factors being considered in the design of the new facility are given. Primary considerations in the channel design are output momentum, polarization of muons, tunability, and beam purity. Suggested experiments with the use of stopped muons include studies of muonium, muon mass, muonic X rays, and muonic hydrogen. A specific neutrino experiment involving muon number conservation is also introduced. A.C.R.

N69-17047# Montana State Univ., Missoula.
SECONDARY BEAM CHANNEL TRANSPORT SYSTEMS
Mark Jakobson *In* Los Alamos Sci. Lab. 1st LAMPF Users' Meeting Sep. 1968 p 33-39 refs (See N69-17041 06-11)
Avail: CFSTI

The experimental area of the Los Alamos Meson Physics Facility, which consists of targets in individual cells serviced by a mobile remote manipulator system, with several secondary channels per cell, is described. The proposed pion channel design is treated, with consideration given to two-bend, three-bend, and four-bend channels. Discussion of the muon channels is confined to the stopped muon channel, since the immediate experimental interest lies in this area. A.C.R.

N69-17071# Naval Research Lab., Washington, D. C.
REPORT OF CYCLOTRON OPERATION, 1 JANUARY-30 JUNE 1968
Oct. 1968 30 p refs
(AD-679172; NRL-MR-1921) Avail: CFSTI CSCL 20/7

The operation and use of the NRL Sector-Focused Cyclotron is described for the period 1 January - 30 June 1968. During this period the major efforts were in facility start-up. These efforts included beam extraction, transport to experimental stations and initiation of the experimental program. The first extracted beam was obtained on 12 February 1968. On 11 March 1968, a beam was transported through the 9-ft. radius of curvature analyzing magnet. On 27 April 1968, a beam was transported into Experimental Room 2. During May, isotope production was initiated in the cyclotron vault, and preliminary measurements on the Doppler-Shift Attenuation Experiment were started in Room 2. In June, preliminary scattering studies were begun in the 30 inch diameter scattering chamber in Room 3. Author (TAB)

N69-17136# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
NEW MULTI-PERIODIC DRIFT TUBE STRUCTURE
S. Giordano 1 Oct. 1968 16 p refs
(BNL-12910) Avail: CFSTI

Improvement of the multi-stem drift tube linac structure by introducing transverse stem resonances (TS modes) is described. Considerable improvement in the stiffening (reduction of field variation due to frequency perturbation) can be obtained by this structure. Various transverse tuning devices are discussed, and TS dispersion curves presented. NSA

N69-17149# National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.
METHOD OF EXPLOSION VENTING A BUILDING
G. E. Simmonds and D. A. Harrison Jul. 1968 11 p ref
(RHEL/R-168) Avail: CFSTI: UK: 2s 6d

Buildings with house plants containing large amounts of liquid propane require special treatment to minimize the risks which can arise. A method is described for achieving the necessary venting should the propane leak and explode. Author (NSA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N69-16130 Michigan Univ., Ann Arbor.
A STUDY OF THE TAYLOR-COUETTE STABILITY OF VISCOELASTIC FLUIDS
Chester Miller (Ph.D. Thesis) 1967 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-7673

Theoretical and experimental consideration is given to the stability of viscoelastic flow between concentric rotating cylinders. In the mathematical analysis, the general Coleman-and-Noll simple fluid with fading memory is employed as the rheological model. General techniques are developed for treating small perturbations on viscometric flows of simple fluids, and these are subsequently applied in analyzing the pertinent stability behavior, under the usual assumption of neutral, axisymmetric disturbances. It is found that there are exactly eight material functions of the rate of shear which are necessary to define this problem. Three of these functions can be determined from existing laboratory tests, but the other five are entirely new, and their form can be deduced theoretically only in the limit of vanishing shear rates. Another important result of the theoretical investigation concerns the definition of one of the stability criteria, the Taylor number. It is shown that this quantity should be calculated using the apparent fluid viscosity, as evaluated at the average shearing conditions in the apparatus. Dissert. Abstr.

N69-16133 Michigan Univ., Ann Arbor.
THRESHOLD PRESSURE PHENOMENA IN POROUS MEDIA
Leonard Kent Thomas (Ph.D. Thesis) 1967 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-7744

The phenomenon was studied of a nonwetting phase, gas, displacing a wetting phase, water, from low permeability porous media such as caprocks overlying natural gas storage reservoirs. Particular attention was given threshold displacement pressures, the minimum pressure needed to initiate the displacement of a wetting phase by a nonwetting phase. A method for measuring the threshold pressures of low permeability porous media is presented. Threshold pressure measurements for eight core samples ranging from 15 to 600 psi were obtained. Water permeabilities for these samples ranged from 10^{-1} to 10^{-5} md. Measurements of porosity, permeability, and formation resistivity factor for each of the samples used were taken in contemplation of using them for predicting displacement pressures. A general correlation between these three simpler but limited correlations were made involving one or two properties. Dissert. Abstr.

N69-16141 Pennsylvania Univ., Philadelphia. Graduate School of Arts and Sciences.
MASS TRANSFER FROM A ROTATING DISC TO NON-NEWTONIAN LIQUIDS
Geoffrey Spearing Hansford (Ph.D. Thesis) 1967 292 p
Avail: Univ. Microfilms: HC $13.20/Microfilm $3.75 Order No. 68-9204

An expression was derived for the rate of mass transfer from a rotating disc to a power-law liquid, using the asymptotic approach derived for high Schmidt numbers. Mass transfer rates were determined experimentally by measuring the rates of dissolution from a rotating disc into solutions of water-soluble polymers. At high rotational speeds the results correlated with the model derived for mass transfer in power-law liquids. The values of the

diffusivities determined by this method were between 100- and 55-percent of their corresponding values in water. Theoretically it can be shown that the diffusivity may either increase or decrease depending upon the interaction of the solute and the polymer solution, but in this case only a decrease was observed. The mass transfer results measured at lower rotational speeds appeared to be related to the secondary flows observed in the liquids. These secondary flows were believed to be due to normal stress effects in the liquids about the rotating disc. Dissert. Abstr.

N69-16142 IIT Research Inst., Chicago, Ill.
EFFECTS OF SURFACTANTS ON MASS TRANSFER INSIDE DROPS
Wann-Sheng Huang (Ph.D. Thesis) 1968 333 p
Avail: Univ. Microfilms: HC $15.10/Microfilm $4.30 Order No. 68-7784

Mass transfer to drops with surfactants soluble in the continuous phase was investigated. The analysis is valid at low Reynolds numbers when the drop has a perfectly spherical shape and the resistance to transfer lies completely in the drop phase. The model developed takes two major factors into account: 1) the reduction in mass transfer area, and 2) the slowing down and changing pattern of the internal droplet circulation due to the presence of surfactant. The barrier theory and the hydrodynamic theory which were controversial in the last two decades are both important. Experimental work was performed to test the model. A system of cyclohexanol saturated with water was used as the continuous phase and pure water droplets were used as the dispersed phase. "Ocenol" and "Zonyl" S-13 were used as surfactants. Gas chromatography was used to analyze the concentration of cyclohexanol in water. The agreement between the experimental and theoretical values are compatible with each other with a deviation of less than 10%. Dissert. Abstr.

N69-16166 Minnesota Univ., Minneapolis.
STRATIFIED FLOW IN HORIZONTAL DUCTS
Hao-sheng Yu (Ph.D. Thesis) 1967 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-7410

Two-component stratified flow in horizontal ducts was investigated both analytically and experimentally. In the analytical phase, a computer oriented solution method was developed for stratified laminar flows in ducts of arbitrary cross section, whereby the velocity field of each component is expressed in closed form. The above method was used to calculate the flow and pressure drop for a circular tube and for a wide range of the independent parameters. For the experimental phase, instead of a circular duct, a 25-foot long rectangular duct (of aspect ratio 0.5) with 1/4"-thick plate glass side walls was constructed to facilitate the visual observation of the interfacial phenomena. The experimental results for flow and pressure drop were found to be insensitive to the shape of the interface and to the presence of very small waves, when both flow components are laminar. The finding suggests that flat interface laminar theory is generally applicable to laminar flows, even if the interface is not flat. Dissert. Abstr.

N69-16173# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
THE INTERMITTENTLY TURBULENT REGION OF THE BOUNDARY LAYER Interim Report
Richard E. Kaplan and John Laufer Nov. 1968 31 p refs
(Contract Nonr-228(33); Grant NSF GK-1256)
(AD-679234; USCAE-110) Avail: CFSTI CSCL 20/4

Measurements were made in the region of the turbulent boundary layer where the flow state alternates between turbulent and non-turbulent. The emphasis of the experiment was to explore the technique of using arrays of hot wire anemometers and analyzing the signals of these wires with a digital computer. A technique similar to the one used is necessary to determine statistics of the intermittent flow more sophisticated than the conventional and familiar intermittency distribution. Techniques and criteria for forming a broader class of ensemble averages for intermittent flows are discussed. In particular, emphasis is placed on the concept of conditional averages of pertinent physical variables in this type of flow. Useful examples of this type of average are the average velocity distribution in the turbulent region, and velocity distributions related to a specified position of the interface between the turbulent and non-turbulent fluid. Author (TAB)

N69-16174# Aeronautical Research Labs., Melbourne (Australia).
AN INVESTIGATION OF BOUNDARY LAYER TRANSITION ON AN AXIAL-FLOW COMPRESSOR BLADE
G. J. Walker (Tasmania Univ.) Jul. 1968 35 p refs
(ARL/ME-122) Avail: CFSTI

The two dimensional boundary layer on an axial flow compressor blade was studied over a wide range of operating conditions. Extensive areas of laminar flow occurred on the blade surface in spite of the high free stream turbulence level from the wakes of upstream blade rows. This suggests that significant improvements in the performance of turbomachine blading should be attainable by choosing blade profile shapes which promote longer lengths of laminar flow. Existing methods of predicting transition were found to be inadequate at the low Reynolds number encountered. A new correlation of transition data, together with the results from tests in flight and in low turbulence wind tunnels, indicates that the distance between the points of instability and transition is dominated by the mean streamwise pressure gradient. Free stream turbulence level apparently had little effect on the transition process itself, and this casts some doubt on the range of validity of transition data from flat plates. A more accurate prediction of viscous flow effects at low Reynolds numbers should be possible through the transition data presented. Author

N69-16175# New York Univ., N. Y.
AN EXPERIMENTAL STUDY OF SOME BASE INJECTION TECHNIQUES AND THE EFFECT OF LARGE PRESSURE GRADIENTS ON TURBULENT DIFFUSION PROCESSES Interim Report
Victor Zakkay, Ram Sinha, and Herbert Fox Aug. 1968 56 p refs
(Contract F33615-68-C-1184)
(AD-679218; ARL-68-0161) Avail: CFSTI CSCL 20/4

Results of an experimental study of some base injection techniques and the effect of large pressure gradients on turbulent diffusion processes in an axisymmetric flow past a slender body at Mach number 3.92 and Reynolds number 3.85 x 10 to the 7th power ft. are presented. Base injection techniques were studied using gaseous hydrogen, helium, nitrogen, and argon as injectants. In each case, it is noticed that the base pressure reaches its peak value much faster (i.e., for a smaller injection rate) with a low molecular weight gas and that a larger increase in base pressure is accomplished with the lighter gas. Some schemes show very irregular behavior in the variation of base pressure with injection. In the study of diffusion processes it is found that the mass diffusion process is not affected at all by the pressure gradients produced in the flow field and that mass, momentum, and thermal diffusion are not the same. This leads to the conclusion that assumptions of Lewis number, Prandtl number, and Schmidt number equal to unity are not correct, especially for problems with large pressure gradients. Author (TAB)

N69-16188 Tennessee Univ., Knoxville.
AN EXPERIMENTAL STUDY OF VISCOELASTIC FLOW IN A CONICAL ENTRANCE REGION
Raymond Leslie Boles, Jr. (Ph.D. Thesis) 1967 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-9793

An experimental study was made of the pressure drop in the conical entrance region to a capillary tube. Two fluids, a Newtonian oil and a viscoelastic polymer solution, were used. The entrance half angle was varied from 10.8° to 90°; the wall shear rate in the capillary was varied from 50 sec.$^{-1}$ to 1000 sec.$^{-1}$. For Newtonian flow, Oka's creeping flow solution was shown to be of the correct form to predict viscous pressure drop effects, although it gave quantitative agreement only at the larger half angles (46.7°). An adaptation of this solution to the power law viscosity model provided a satisfactory prediction of non-Newtonian viscous effects. Weissberg's solution for flow in a sharp-edged entrance (... -90°) gave excellent agreement with experimental data. For viscoelastic flow, the data were correlated semiempirically using an equation that involved a nonlinear viscous term and an elastic term. Dissert. Abstr.

N69-16191 Illinois Univ., Urbana.
ANALYTICAL STUDY OF FLOW PAST A CIRCULAR CYLINDER AT LOW REYNOLDS NUMBERS
Thomas Joon-Mock Kim (Ph.D. Thesis) 1967 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-8135

An asymptotic expansion technique is used to obtain approximate solutions for the Navier-Stokes equation which are valid for arbitrary values of the Reynolds numbers. The technique used is based on coordinate rather than parameter expansions and is influenced by the spirit of Kaplun's method of the matched asymptotic expansion. Two asymptotic expansions of flow variables are constructed which are valid near the boundary of a circular cylinder and in the neighborhood of infinity, respectively. It is found that the expansion near the inner boundary may always be expressed in terms of two arbitrary functions which represent the shearing stress and the pressure distribution on the surface of the body, respectively. On the other hand, the expansion which is valid near the outer boundary is obtained by successive determination of the coefficients of expansion which are general solutions of systems of linear ordinary differential equations. Dissert. Abstr.

N69-16193 Minnesota Univ., Minneapolis.
VISCOUS INSTABILITY OF ASYMMETRICAL PARALLEL FLOWS IN CHANNELS
Tsun-sen Fu (Ph.D. Thesis) 1967 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-7314

The two critical point problem of the Orr-Sommerfeld equation is investigated by both asymptotic methods and finite difference integrations. Three families of basic flows are studied. First is examined one parameter family of asymmetrical parallel flows with velocity profiles of one signed curvature which can be obtained from plane Poiseuille flow by varying the parameter. It is found that the critical Reynolds numbers increase with the skew of these velocity profiles. Secondly, a family of velocity profiles generated by allowing viscosity to vary with temperature are studied. Increasing the viscosity parameter not only can distort the basic flow but also can introduce a single inflection point. Thirdly, the viscous and inviscid Orr-Sommerfeld equations are studied for a family of velocity profiles which possess two inflection points but are not necessarily symmetrical. Dissert. Abstr.

N69-16200 West Virginia Univ., Morgantown.
DYNAMIC ANALYSIS OF CHEMICAL REACTOR MODELS AND THE LONGITUDINAL DISPERSION OF LIQUID FLOWING THROUGH FIXED AND FLUIDIZED BEDS
Seng Fang Chung (Ph.D. Thesis) 1967 223 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-8339

The purpose of this work was two fold: first, to develop the dynamic response equations based on impulse, step, ramp, parabolic and sinusoidal inputs for reactors of various flow models, second, to study the characteristics of the liquid phase longitudinal dispersion in fixed and fluidized beds. The chemical reactor models considered for the derivation of dynamic response equations were: dispersion models, mixing cell models, combined models, backflow models, circulation models, random-walk model and convective models. Dynamic response experiments were performed to show how the parameters of a model namely the dispersion model can be obtained. A 2 inch diameter column of fixed and fluidized beds was used. The tracer was a light emissive fluorescein dye. Variables studied were water flow rate, fraction voids, particle size, particle density. Sinusoidal testing and pulse testing techniques were applied in frequency domain analysis. Dissert. Abstr.

N69-16201 Princeton Univ., N. J.
RECUPERATIVE PARAMETRIC PUMPING: MODEL DEVELOPMENT, EVALUATION, AND USE FOR STUDY OF SEPARATION CAPABILITIES
Roger William Rolke (Ph.D. Thesis) 1968 179 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-9690

Parametric pumping is a novel separation process depending on dynamic coupling of a periodic relative axial displacement between two phases and a periodic interphase solute flux to produce a net axial solute flux and a separation. Sodium chloride in dilute solution is considered as the solute and a mixed bed of weak ion exchange resins as the fixed, second phase. The temperature dependence of the interphase equilibrium is utilized to bring about the periodic interphase solute flux. Heat enters and leaves the column with the flowing fluid in this recuperative model of parapumping. A valid computer model, which successfully predicts experimental behavior, was developed based on differential equation forms of solute and heat balances, the respective rate expressions for interphase transfer, and the interphase equilibrium expression. Interphase solute transfer was considered both from a lumped parameter and a distributed parameter standpoint, the latter including radial concentration profiles inside resin particles. Methods of difference equation solution of the basic differential equations and resulting problems were studied, especially with regard to the introduction of diffusive effects. Dissert. Abstr.

N69-16226 Washington Univ., St. Louis, Mo.
A NEW ANALYTICAL MODEL DERIVED FROM EXPERIMENTAL STUDIES ON THE ENERGY TRANSFER ACROSS MOVING GASEOUS INTERFACES
James Donald McBrayer (Ph.D. Thesis) 1968 219 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-10796

The energy transfer across moving gaseous interfaces was investigated with a rotary jet flow induction device. The density ratio of the two gases was varied between 1:1 and 1:7 by using either air or appropriate mixtures of helium and nitrogen as the primary gas. The primary total pressure ranged from 1 to 40 psig. The rotary flow induction model used a number of different nozzle hubs, each with three circular nozzle inserts at a 15° coning angle with respect to the axis of rotation. These nozzles had a variety of spin inducing cant angles between 0° and 20°. Two types of nozzle inserts were used to vary the shroud exit velocity profiles. A new analytical flow model was developed with a changed flow pattern with respect to jet entrainment. The values of the jet entrainment coefficient were determined by fitting the results of the analytical model to the experimental data. This entrainment coefficient was found to vary directly with the ratio of air density to test gas density and to vary inversely with primary pressure. Dissert. Abstr.

N69-16232# Colorado State Univ., Fort Collins.
APPROACH OF TURBULENT BOUNDARY LAYER TO SIMILARITY
Dusan L. Zoric Sep. 1968 222 p refs
(Contract DA-AMC-28-043-65-G20)
(AD-679202; CER68DLZ9) Avail: CFSTI CSCL 20/4

A large scale turbulent boundary layer with no pressure gradient, developed on a flat plate 95 feet long was investigated. Theoretical considerations of the existence of local similarity yield the requirements which should be found in the turbulent boundary layers in order that similarity exists. Measurements of the mean motion, the turbulent velocity components and the turbulent shear stress were made for the free stream velocity range 60 to 100 ft/sec. Reynolds numbers based on the boundary layer thickness were of the order of 1,000,000. Turbulence quantities were evaluated from a single rotating hot-wire probe along the entire length of the boundary layer. For all quantities measured, the uncertainty intervals were calculated in order to provide a measure of the reliability of the results. The large scale turbulent boundary layers are shown to approach closely the theoretical requirements for similarity. Displacement and momentum thickness grow as a linear function of x-coordinate, the form factor is constant. The constant wall shear stress requirement is very closely approached. An asymptotic similarity form is considered and reported. For similarity function of the turbulent shear stress distribution across the boundary layer thickness, an approximate linear function is proposed. The best average universal velocity profile is tabulated. Author (TAB)

N69-16239 University of Southern Calif., Los Angeles.
STATIONARY RADIAL SOURCE FLOW OF LIQUID PARTICLES INTO VACUUM
Lewis Alan Glenn (Ph.D. Thesis) 1968 190 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-10232

By means of this shooting/splitting technique, it was possible to investigate in parametric fashion, the effects on the flow structure of such variables as the initial particle size, evaporation coefficient, drag coefficient, heat transfer coefficient, initial particle volume fraction, injection velocity, and temperature. It is shown that the flow field is characterized by a rapid departure from initial dynamic and thermal equilibrium with the action of interphase mass, momentum, and energy transfer providing the throat through which supersonic flow is attained. Moreover, the location of the throat is a strong function of the local evaporation rate, the latter in turn being influenced by the fluid properties, but primarily by the injection conditions and the initial particle size. Increasing the evaporation coefficient or initial injection temperature for nonzero particle size tends to reduce this distance whereas an increase in the drag coefficient, initial particle volume fraction, or injection velocity produces the opposite effect. Dissert. Abstr.

N69-16254 Cornell Univ., Ithaca, N. Y.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE FLOW OF AIR-WATER AND STEAM-WATER MIXTURES IN A CONVERGING-DIVERGING NOZZLE
Garry Charles Carofano (Ph.D. Thesis) 1968 225 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-9878

An analytical and experimental study was made of the flow of air-water and steam-water mixtures in a two-dimensional converging-diverging nozzle. A one-dimensional flow model was constructed based on a mist flow pattern and the mass, momentum and energy transfer rates between the two phases were included explicitly. The model was used to compute the pressure distribution along the nozzle and the choking flow rate for comparison with the experimental measurements. The predicted pressure distributions in the convergent section of the nozzle agreed fairly well with the experimental values for both single- and two-phase runs. The data generally fell above the theoretical predictions in the divergent section but most of the discrepancy could be attributed to condensation effects due to the formation of nucleation sites within the vapor phase. Homogeneous nucleation, which was neglected in the theory, was found to be important only in the divergent section of the nozzle. Dissert. Abstr.

N69-16284 National Lending Library for Science and Technology, Boston Spa (England).
SOME ASPECTS OF MIXING OF SOLID PARTICLES IN A FLUIDISED BED [NEKOTORYE ZAKONOMERNOSTI PEREMESHIVANIYA TVERDYKH CHASTITS V KIPYASHCHEM SLOE]
G. M. Voldman et al. Oct. 1968 6 p refs Transl. into ENGLISH from Izv. Vys. Ucheb. Zav. Tsvetnaya Met. (USSR), v. 9, no. 6 p 36-40
(NLL-RTS-4699) Avail: Natl. Lending Library, Boston Spa, Engl.: 12s 6d

The mixing coefficients were determined for solid particles with particle sizes 0.2, 0.375, and 0.65 mm. The fluidized bed consisted of quartz sand 0.1 to 0.5 mm and 0.1 to 0.25 mm. The coefficients were determined at air velocity close to the minimum fluidizing velocity and at values up to three times exceeding it. Depending on the air flow and the particle size the coefficient varied from 0.23 to 6.6cm^2/sec. The mixing coefficient for solid particles varies linearly with air flow and is equal to zero at minimum fluidising velocity. An empirical formula is proposed relating the mixing coefficient with particle size and air flow. Author

N69-16287 Oklahoma Univ., Norman.
AN INVESTIGATION OF THE FLOW OF POLYMER SOLUTIONS THROUGH POROUS MEDIA
A. Herbert Harvey (Ph.D. Thesis) 1968 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-9865

The mechanism of flow of a high molecular weight polymer solution through porous media is incompletely understood. The purpose of this study is to develop a more satisfactory theory to describe this flow and to investigate rheologic properties of certain polymer solutions which are of interest from the standpoint of possible application to polymer flooding. The Ergun friction factor equations for non-Newtonian fluids have been modified empirically to obtain relationships which may be used to predict the flow of certain solutions of polyethylene oxide, polyacrylamide, and polysaccharide through unconsolidated porous media. A parallel plate viscometer has been used to test dilute polyacrylamide and polysaccharide solutions for viscoelasticity. Capillary viscometer data have been obtained for fifteen polyacrylamide solutions and four polysaccharide solutions. Dissert. Abstr.

N69-16301 Rochester Univ., N. Y.
MULTIPHASE MULTICOMPONENTS HYPERSONIC BOUNDARY LAYERS
Shy-Shung Hwang (Ph.D. Thesis) 1968 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-9377

This thesis reviews the problem of a laminar boundary layer on a flat plate with heat and mass transfer. Previous work is reviewed and the fundamental equations are derived. The case of a compressible laminar boundary layer with melting and evaporation of a boron oxide boundary is solved. Ordinary differential equations result from a transformation involving a modified Blasius parameter which includes the Dorodnitzyn variable. The method of integration is a predicator-corrector method that uses the Falkner multiple-integration extrapolation formulas and the Adams-type multiple-integration interpolation formulas. All the parameters are functions of temperature and concentration. Solutions were carried

out on the IBM 7074 digital computer. It is shown that the results using accurate and what has been acceptable approximate transport properties are quite different, the error reaches more than 50%. The large reduction of heat transfer has been obtained as a result of evaporation. For an evaporation rate f(0) = −.1 the ratio of Stanton number for heat transfer with and without evaporation is only 0.3. Skin friction coefficient is also reduced. For f(0) = −.1, it is reduced about 18%. The molten liquid layer is quite thin compared to gas boundary layer. Dissert. Abstr.

N69-16315 Colorado State Univ., Fort Collins.
VISCOUS REGION OF TURBULENT BOUNDARY LAYER
Henry William Tieleman (Ph.D. Thesis) 1967 217 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-7821

The nature of mean and turbulent motion in the viscous sublayer of a thick boundary layer with zero pressure gradient has been investigated. Measurements were made of the mean motion, two of the turbulent velocity components, the turbulent shear stress, and spectra of the longitudinal component of the velocity fluctuation. Traverses were made through approximately one-fifth of the boundary layer, which was approximately 32 inches thick. The boundary layer was developed along the floor of the wind tunnel test section for 85 feet. The turbulent shear stresses and the turbulence intensities were evaluated from a single rotated wire. A detailed account is given of the theory concerning the yawed wire operation. Included are corrections for the results from normal and yawed hot wires when operated in large mean velocity gradients and/or turbulence intensity gradients. Dissert. Abstr.

N69-16321# Ballistic Research Labs., Aberdeen Proving Ground, Md.
RAREFACTION SHOCK POSSIBILITY IN A VAN DER WAALS-MAXWELL FLUID
George D. Kahl and Donald C. Mylin Oct. 1968 34 p refs
(AD-678562; BRL-1421) Avail: CFSTI CSCL 20/4

The rarefaction shock is found to be impossible practically in an equilibrium Van der Waals-Maxwell fluid, in and across all phase regions. The existence of this type shock depends explicitly on the constant-volume heat, as well as the pressure equation of state. The form of specific heat assumed includes contributions from translation, rotation, and vibration energies of the molecule; Einstein functions are used to represent the latter. In particular, the vaporizing expansion wave in the saturated liquid phase cannot be discontinuous. Metastable states of supersaturation are not considered. Despite the results for this theoretical model, the necessary conditions for the rarefaction shock are found to be satisfied, in principle, for a small region near the critical point of a real two-phase fluid (steam). Author (TAB)

N69-16364# ARO, Inc., Arnold Air Force Station, Tenn.
A REVIEW OF THE ANALYTICAL METHODS APPLIED TO THE SEPARATED TURBULENT BOUNDARY-LAYER PROBLEM Final Report, 5 Jun.–1 Sep. 1967
J. P. Wallace Arnold Eng. Develop. Center Nov. 1968 35 p refs
(Contract F40600-68-C-0001)
(AD-678524; AEDC-TR-68-210) Avail: CFSTI CSCL 20/4

An investigation of the various parameters that affect separation was undertaken to determine if scale effects exist. For example, in incompressible flow a full, thick, turbulent boundary layer will separate more readily in an adverse pressure gradient than a thin boundary layer. The emphasis throughout is on the two-dimensional, forward facing step and compression corners and the shock wave boundary-layer interaction. Author (TAB)

N69-16371# Michigan Univ., Ann Arbor, Inst. of Science and Technology.
ASYMPTOTIC SOLUTIONS FOR SUPERSONIC ROTATIONAL FLOW AROUND A CONVEX CORNER USING A NEW COORDINATE SYSTEM
T. C. Adamson, Jr. Oct. 1968 69 p refs
(Contract DAHC15-67-C-0062)
(AD-678583; Rept-8430-1-7) Avail: CFSTI CSCL 20/4

A coordinate system consisting of the left-running characteristics (alpha = constant) and the streamlines (psi = constant) is used. The governing equations are derived in terms of alpha and psi for a two-dimensional, steady, supersonic, rotational, inviscid flow of a perfect gas. The equations are applied to the problem of an initially parallel, supersonic, rotational flow which expands around a convex corner. The velocity of the incoming flow at the wall is considered to be either supersonic or sonic. For each case, solutions uniformly valid in the region near the leading characteristic and in the region near the corner are found for the Mach angle and flow-deflection angle in terms of their values on the leading characteristic and at the corner. In the second case, a transonic similarity solution is found and composite solutions are constructed for each region. Comparisons are made with existing exact numerical results. Author (TAB)

N69-16418 Iowa Univ., Iowa City.
FLUID JET TRANSMISSION OF A PRESSURE SIGNAL FROM A ROTATING SHAFT TO A FIXED RECEIVER
Richard Terrell Johnson (Ph.D. Thesis) 1968 175 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-10865

Two axisymmetric jets are attached to the shaft, intersecting each other at right angles. The primary or power jet is symmetric about the axis of rotation of the shaft, while the secondary or control jet is perpendicular to this axis. The resulting flow from the intersection of these jets impinges on a fixed receiver plane which contains an orifice to sense the resulting pressure due to deceleration and deflection of the velocity field. A satisfactory mathematical model for the steady-state, no load operation of the device was obtained. In developing the model, the flow phenomena involved were examined in four studies: (1) the submerged jet; (2) a jet impinging on a normal plane; (3) the effect of an intersecting jet on downstream velocity fields; (4) description of the output pressure of the device in terms of the quantities developed in the three previous studies. Information required to make use of the fluidic transmitter with other fluid devices is presented in graphical form. Dissert. Abstr.

N69-16434# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
INNER AND OUTER FLOW VELOCITY DISTRIBUTIONS THROUGH TALL SIMULATED VEGETATION
S. Ito and J. E. Cermak Apr. 1968 66 p refs
(Contract DA-AMC-28-043-65-G20)
(AD-678592; CER67-68JEC61) Avail: CFSTI CSCL 4/2

The velocity distribution in and above model vegetation is the subject of this study. Experiments have revealed that flow over a surface which has been made rough by covering it with tall simulated plants may have a universal distribution law. Author (TAB)

N69-16444 Rochester Univ., N. Y.
STABILITY OF VISCOELASTIC JETS
Fidel William Kroesser (Ph.D. Thesis) 1968 169 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-9381

The breakup of a horizontal jet, under the influence of a symmetric disturbance, was investigated. Weber's theory for the

breakup of a newtonian jet was extended to a linear viscoelastic fluid. The theory predicts a dependence of breakup length on the Elasticity Number. Breakup lengths were measured experimentally for low concentration solutions of polyisobutylene in tetralin. A single correlation was obtained for all data studied, which gives the breakup length as a function of the Elasticity Number, and the parameters developed by Weber. At constant values of the Ohnesorge Number and Weber Number, the breakup length decreases with increasing Elasticity Number. Also, short tubes give rise to slightly shorter breakup lengths than long tubes under the same flow conditions. The cause of flow instability within the tube under certain conditions was suggested to be the same as that for melt fracture often observed in the extrusion of polymer melts.
Author

N69-16446# National Aeronautical Establishment, Ottawa (Ontario).
NON-UNIFORM PROPAGATION OF MODERATE STRENGTH BLAST WAVES IN WEDGE AND CONICAL HYPERSONIC NOZZLES
B. H. K. Lee Natl. Res. Council of Canada Jun. 1968 30 p refs
(NCR-10409; NAE-LR-505) Avail: CFSTI

The blast wave equations in an unsteady environment are derived. For wedge and conical nozzles it is shown that the density has a power law variation with distance downstream from the throat when the local flow Mach number is large. The unsteady flow field behind the blast wave is solved by a perturbation technique and the self-similar solution of Mirels and Mullen is recovered in the first approximation. An approximate expression is given for the shock trajectory as a function of the instantaneous energy release, the nozzle geometry, and the stagnation conditions.
Author

N69-16455# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLUID AND GAS MECHANICS (SELECTED ARTICLES)
25 Oct. 1967 31 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), no. 1, 1966 p 101–104; 128–130; 158–161; 168–170
(AD-678765; FTD-HT-23-750-67) Avail: CFSTI CSCL 20/4

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1. TAYLOR INSTABILITY OF A LIQUID FILM ON A BODY A. A. Zaytsev p 1–6 refs (See N69-16456 06-12)

2. FLOW PAST A PERMEABLE CONE AT AN ANGLE OF ATTACK Ye. M. Kalinin p 7–10 refs (See N69-16457 06-01)

3. CALCULATION OF AN AXISYMMETRIC JET FLOWING OUT OF A NOZZLE WHEN THE PRESSURE IN THE JET IS LOWER THAN THE AMBIENT PRESSURE E. A. Ashratov p 11–16 refs (See N69-16458 06-12)

4. VIBRATIONS OF LIQUID IN PIPES AT MODERATE REYNOLDS NUMBERS S. I. Sergeyev p 17–22 refs (See N69-16459 06-12)

N69-16456# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TAYLOR INSTABILITY OF A LIQUID FILM ON A BODY
A. A. Zaytsev *In its* Fluid and Gas Mech. (Selected Articles) 25 Oct. 1967 p 1–6 refs (See N69-16455 06-12)
Avail: CFSTI

Orr–Sommerfeld equations are used to describe the stability conditions for the flow of a viscous layer on a body around which low viscosity liquid is flowing. Several cases are studied and it is shown that for an inclined plane flow where an adjacent viscous liquid flows parallel to the plane with a low viscosity liquid flowing above, a set of conditions can be found where only three-dimensional waves can exist. If the viscous layer is sufficiently thin, slowly growing two-dimensional longitudinal excitations can appear. If the layer is sufficiently thick, still another effect, Helmholtz instability, with a wide frequency range, appears. Such effects have been observed in the surface structure of meteorites when their outer skin has melted during their passage through the atmosphere.
Author

N69-16458# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF AN AXISYMMETRIC JET FLOWING OUT OF A NOZZLE WHEN THE PRESSURE IN THE JET IS LOWER THAN THE AMBIENT PRESSURE
E. A. Ashratov *In its* Fluid and Gas Mech. (Selected Articles) 25 Oct. 1967 p 11–16 refs (See N69-16455 06-12)
Avail: CFSTI

The problem of a supersonic axisymmetric stream in an environment of higher pressure is investigated by a method which accounts for subsonic flow near the symmetry axis. The problem is characterized by a density discontinuity at the nozzle. Cylindrical coordinates are used with the Mach number of the free stream, relative heat capacity, and relative pressure referred to ambient conditions as parameters. The computation method first determines the point where density discontinuity branches out into one going toward the free streamlines and the other toward the axis of symmetry. This method of characteristics is used to integrate the equations of motion. The computations were made for the reference Mach number of 2.8 and 3.2 for various ratios of pressures. The comparison of numerical computations with the experimental data proves the effectiveness of the method used for the determination of the structure of the initial section of such an axisymmetric stream.
Author

N69-16459# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VIBRATIONS OF LIQUID IN PIPES AT MODERATE REYNOLDS NUMBERS
S. I. Sergeyev *In its* Fluid and Gas Mech. (Selected Articles) 25 Oct. 1967 p 17–22 refs (See N69-16455 06-12)
Avail: CFSTI

The transition regime in liquids during the change from oscillating flow to turbulent flow is studied. Tests have been performed on liquids in pipes with initial laminar flows. The flow in the pipes is formulated mathematically to elicit the effects of various constants on the form of the solution. These effects are then related to the experimental observations. The transition regime was studied using water as a working liquid with addition of aluminum powder for visualization. The observations were made with both free and forced oscillations superimposed on the liquid flow. It was found that the critical Reynolds number is linear with inertia coefficient in a wide range of Reynolds numbers. The friction and inertia was derived from the damping and the frequency of free oscillations. The experiment has shown that flow stability increased and its characteristics depend on the parameters of the oscillations.
Author

N69-16500 Michigan Univ., Ann Arbor.
STABILITY OF NATURAL CONVECTION IN A VERTICAL SLOT
Charles Marsteller Vest (Ph.D. Thesis) 1967 119 p
Avail: Univ. Microfilms HC $5.80/Microfilm $3.00 Order No. 68-7749

The stability of the natural-convective motion of a viscous fluid contained in a vertical slot having isothermal side walls of different temperatures is analyzed. If the wall temperature difference is small this motion is unicellular, with fluid rising adjacent to the hot wall and descending adjacent to the cold wall. It is shown that if the wall temperature difference exceeds a critical value this

motion becomes unstable and a secondary, multicellular, laminar motion appears in the slot. The critical value of the wall temperature difference and the geometric form of the secondary motion are analytically predicted. These results are corroborated by a flow-visualization experiment. It is concluded that antisymmetric natural-convective flows are unstable with respect to certain stationary modes of disturbance, and that this instability has been analytically predicted and experimentally observed. Dissert. Abstr.

N69-16518 Oklahoma State Univ., Stillwater.
DISTILLATION COLUMN DYNAMICS, AN EXPERIMENTAL STUDY
William Galloway Osborne, Jr. (Ph.D. Thesis) 1967 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-8473

A series of 12 experimental runs have been made to aid in the development of a dynamic model for a distillation column. Three of the runs were made on a ternary system and nine on binary systems. The runs differed in feed compositions and/or the ratio of the distillate rate to the feed rate. The results of the experimental runs have been used to test a proposed dynamic model for a distillation column. Additionally, the dynamic model has been incorporated into a feed forward control scheme to show its utility in control applications. With the experimental results, the dynamic model has been shown to describe the transient behavior of a distillation column. Dissert. Abstr.

N69-16535 Columbia Univ., New York.
AXIAL DISPERSION DURING PULSATING PIPE FLOW
Harry Madison Taylor (Ph.D. Thesis) 1967 256 p
Avail: Univ. Microfilms: HC $11.70/Microfilm $3.30 Order No. 68-8625

A study was made of the effect of pulsations on axial dispersion in water flowing turbulently through a straight length of open, round pipe. Test pipes of two different internal diameters were used and two types of experiments were performed: one in which the flow was steady and yielded typical axial dispersion data, and another in which cyclic variations were imposed on the bulk flow. For both types of experiments a dye tracer was injected into the flowing fluid as a finite pulse to yield the transient response of the system. The input and output concentration distributions were monitored by a continuous colorimeter system which eliminated the need for removing samples from the flowing fluid. Continuous data representing the concentration distributions and the flow variations were collected on-line using an analog magnetic tape recorder. It was found that the one-dimensional axial dispersion model sufficed to describe the results for both steady and unsteady flow. Dissert. Abstr.

N69-16557 Minnesota Univ., Minneapolis.
MIXING AND CHEMICAL REACTION IN TURBULENT SHEAR FLOWS
Robert Steven Torrest (Ph.D. Thesis) 1967 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-7397

Microconductivity probes were used for the measurement of point values of mean concentrations and root mean square concentration fluctuations for mixing of salt solutions in turbulent shear flows. Mixing studies covered a range of flow conditions, with Reynolds numbers on the order of 10^4, and included ducted turbulent jets, dispersion in turbulent pipe flow, a plane mixing layer, and several multiple injection systems. The test sections all had characteristic dimensions of about 2 cm. The results for mixing experiments are compared with available previous work. Lack of resolution for too root mean square concentration fluctuations in some previous work is indicated. Reaction product concentrations for a rapid, second order, irreversible reaction in multiple injection systems, the plane jet, and the mixing layer were also obtained. The relation between conversion in reaction experiments and fluctuation level and decay in the equivalent mixing experiments is qualitatively illustrated, as is the effect of flow conditions. Dissert. Abstr.

N69-16563# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT AND MASS TRANSFER (SELECTED ARTICLES)
9 Nov. 1967 23 p refs Transl. into ENGLISH from Teplo-Massoperenos. (Minsk), v. 2, 1965 p 305-312; 369-376
(AD-678766; FTD-HT-23-775-67) Avail: CFSTI CSCL 20/4

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2. APPLICATION OF THE THEORY OF SIMILARITY IN A STATISTICAL ANALYSIS OF THE ANISOTROPY OF TURBULENCE S. G. D'yakonov et al p 10-16 refs (See N69-16565 06-12)

N69-16564# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STUDY OF THE TURBULENT BOUNDARY LAYER FORMED ON THE STREAMLINING OF A PLATE BY FLOW OF A COMPRESSIBLE GAS WITH HEAT TRANSFER
L. M. Zysina-Molozhen et al *In its* Heat and Mass Transfer (Selected articles) 9 Nov. 1967 p 1-9 refs (See N69-16563 06-12)
Avail: CFSTI

The experimental investigations of the effect of the temperature factor on heat transfer and surface resistance in a stream of compressible gas were carried out in the optical unit of a supersonic aerodynamic tube. The experiments were made over a range of the temperature factor from 1.0 to 2.2 at a Mach number of approximately 1.5 and a Reynolds number of 10^7. The length of the working section was 0.5 meters. Results are shown in a series of curves. It was found that at values of the temperature factor substantially less than unity, it is necessary to take into account the dependence of the thickness of the laminar sublayer on the Mach number, and particularly on the temperature factor. At values of the temperature factor less than unity, the effect of the Mach number and the temperature factor on the turbulent transfer constants can in practice be neglected. When the Mach number is less than 3.0, a decrease in the resistance coefficient by not more than 20% results. Author

N69-16565# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF THE THEORY OF SIMILARITY IN A STATISTICAL ANALYSIS OF THE ANISOTROPY OF TURBULENCE
S. G. D'yakonov et al *In its* Heat and Mass Transfer (Selected Articles) 9 Nov. 1967 p 10-16 refs (See N69-16563 06-12)
Avail: CFSTI

Assuming the similarity of systems with a large number of degrees of freedom, attempts to evaluate the distribution function for the turbulent velocity pulsations in anisotropic turbulence are made. This offers the possibility of solving the Reynolds equation. The article demonstrates by an extended mathematical development that use of the kinetic entropy equation for investigation of anisotropic turbulence makes it possible to close the system of equations for the turbulence, and to obtain information on the internal structure of flow with transverse slip without assumptions of any kind as to the distribution of any of the variables over the cross section of the flow. Author

N69-16587 West Virginia Univ., Morgantown.
A VARIATIONAL SOLUTION OF THE TAYLOR STABILITY PROBLEM BASED UPON NON-EQUILIBRIUM THERMODYNAMICS
David Edward McKee (Ph.D. Thesis) 1967 157 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-8345

A generalized variational technique for solving hydrodynamic stability problems is developed based on nonequilibrium thermodynamics. A generalized functional is found by extending the methods of Glansdorff and Prigogine. The applicability of this method is demonstrated by solving the well-known Taylor problem for the stability of a viscous fluid contained between rotating concentric cylinders. Both the wide and narrow gap problem were considered with and without an imposed radial temperature gradient. The results obtained are in good agreement with both analytical and experimental data. Dissert. Abstr.

N69-16593# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
A THEORY OF PLUME RISE COMPARED WITH FIELD OBSERVATIONS
David P. Hoult, James A. Fay, and Larry J. Forney Mar. 1968 30 p
(PUBL-68-2; PB-179536) Avail: CFSTI CSCL 13B

A theory for the rise of a plume in a horizontal wind is proposed in which it is assumed that, for some distance downwind of a high stack, the effects of atmospheric turbulence may be ignored in comparison with the effects of turbulence generated by the plume. The theory has two empirical parameters which measure the rate surrounding fluid entrained into the plume. Laboratory measurements of buoyant plume motion in laminar unstratified cross flow are used to evaluate the empirical parameters. Using this determination of the parameters in the theory, the trajectories of atmospheric plumes may be predicted. To make such a prediction, the observed wind velocity and temperature as functions of altitude, and flow conditions at the stack orifice, are used in numerically integrating the equations. Author (USGRDR)

N69-16673 National Lending Library for Science and Technology, Boston Spa (England).
THE MOVEMENT AND MIXING OF SOLID PARTICLES IN A FLUIDISED BED [DVIZHENIE I PEREMESHIVANIE CHASTITS TVERDOI FAZY V PSEVDZHIZHENNOM SLOE]
O. M. Todes et al [1968] 13 p refs Transl. into ENGLISH from Khim Prom. (Leningrad), v. 42, no. 6, 1966 p 408-413
(NLL-RTS-4702) Avail: Natl. Lending Library, Boston Spa, Engl.

Numerical data obtained in experiments on the structure and properties of the fluidized bed are analyzed. Measurements made with a special turbulence meter in conjunction with a photographic record indicated that the characteristic movement of solid particles in a fluidized bed is close to the turbulent pulsations of the liquid, but that the scale of movement of particle groups is also comparable to the size of the bed itself. The particles were impregnated with thorium salts and irradiated with X-rays or marked with radioactive tracers. From the experimental data, the application diffusion theory to the mixing of particles in a fluidized bed is analyzed, and methods of measuring the effective coefficient of diffusion of marked particles are investigated. A continuous method was developed using a small high sensitivity magnetic probe to directly measure and record the local concentration of magnetically marked particles within the bed. This method appears to overcome some of the difficulties encountered with other techniques. A.C.R.

N69-16681 Illinois Univ., Urbana.
NUMERICAL TREATMENT OF LAMINAR FREE SURFACE FLOWS
Balbir Singh Narang (Ph.D. Thesis) 1967 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-8181

We have solved numerically the full Navier-Stokes equations for unsteady, two-dimensional viscous flow of an incompressible fluid bounded in part by free surfaces. Obviously, the actual boundary conditions are derived from the consideration of balance of normal stress at the free surface, and from continuity of the tangential stresses across the surface. The boundary conditions can be expressed as functions of velocity and slope at the free surface. It has been possible for us to develop a simple finite difference analog scheme which enables us to apply the real boundary conditions at the free surface. The scheme involves making a least square polynomial fit to the free surface cell locations for each time-step, from which information concerning the local orientation and curvature of the free surface may be deduced. Dissert. Abstr.

N69-16688# Stanford Univ., Calif. Dept. of Civil Engineering.
A STEADY-STATE SIMULATION OF SMALL AMPLITUDE WIND-GENERATED WAVES
Ronald F. Ott, En Yun Hsu, and Robert L. Street Aug. 1968 91 p refs
(Contract Nonr-225(71); Grant NSF GK-736)
(AD-678739; TR-94) Avail: CFSTI CSCL 20/4

The primary purpose of this investigation was to extend and to improve the results of Zagustin, et al., on steady-state, experimental simulation of wind blowing over small amplitude waves. Experiments were performed in a laboratory open-channel flume in which a belt driven at a constant speed and following the shape of the wave reproduced the moving boundary conditions found at an air-water interface. Water was used as a working fluid. Two sets of new experimental results are presented. The first set was a rerun of the Zagustin experiments in which the moving belt formed one wall of the open channel. Emphasis was placed on increasing the scope and accuracy of the previous results. In the second set of experiments, a cover-plate was added to the open flume to minimize the free-surface disturbances. In both sets of experiments, a pitot-static probe was used to obtain velocity and pressure data. The measured velocity profiles in the flow above the wavy surface were used together with Miles theory to obtain theoretical pressure distributions for the region near the wavy surface. These were compared to the experimental distributions. Within the limitations of the experimental model, the data verified Miles inviscid mechanism of energy transfer from a shear-flow to pre-existing small amplitude waves. Author (TAB)

N69-16728# Wisconsin Univ., Madison. Mathematics Research Center.
UNSTEADY VISCOUS FLOW DUE TO A ROTATING BLADE Technical Summary Report
C. R. Illingworth Jul. 1968 32 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-678962; MRC-TSR-801) Avail: CFSTI CSCL 20/4

The equations for unsteady boundary-layer flow on a rotating blade are obtained. Solutions are given in three particular cases, one being concerned with boundary-layer growth and the two others with periodic boundary layers. Author (TAB)

N69-16757# Aerospace Corp., El Segundo, Calif. Lab. Operations.
THE STABILITY OF A VISCOUS HETEROGENEOUS SHEAR FLOW
Frank D. Hains Jul. 1968 37 p refs
(Contract F04695-67-C-0158)
(AD-678512; TR-0158(3240-20)-18; SAMSO-TR-68-411) Avail: CFSTI CSCL 20/4

A numerical method is used to compute the stability of a shear layer embedded between two homogeneous fluid regions

of different densities that are moving at uniform but different velocities. The mean flow is specified by a hyperbolic tangent velocity profile and an exponential of a hyperbolic tangent density profile. Numerical results are presented that show the changes in the stability of the layer with the Reynolds number, Froude number, wavenumber of the disturbance, and the gradients of shear and density. Two modes of instability are found: one propagates upstream relative to the moving fluid, the other propagates downstream at a velocity that is always less than the average of the two outer regions. Viscosity tends to stabilize waves that are already stable and to destabilize waves that are unstable. The neutral stability curves appear to have only one branch; therefore, no critical Reynolds numbers were found. Gravity tends to stabilize one mode and to destabilize the other; but when gravity forces are very large, both modes are stabilized. One mode was unstable when the minimum Richardson number across the shear layer exceeded 1/4; therefore, the critical Richardson number for a viscous fluid must be larger than that for an inviscid fluid. Author (TAB)

N69-16786 Notre Dame Univ., Ind.
NUMERICAL SOLUTIONS OF COMPRESSIBLE AND INCOMPRESSIBLE LAMINAR SEPARATED FLOWS
Patrick J. Roache (Ph.D. Thesis) 1968 473 p
Avail: Univ. Microfilms: HC $21.04/Microfilm $6.05 Order No. 68-9418

Numerical techniques and solutions for both incompressible and compressible laminar separated flows using time-dependent finite difference equations are presented. These include backstep or base flows with and without splitter plates, and flow over rectangular cavities. Conservative forms are used, and the Transportive Property is defined. Upwind differencing is used for the advection terms in both compressible and incompressible flow, and a two time-level predictor-corrector analog of the DuFort-Frankel scheme is used for diffusive terms in the compressible flow. Particular attention is paid to the boundary condition problems, especially the adjusting upstream vorticity, the vorticity at the sharp corner and the downstream continuation in incompressible flow, and the adjusting inflow through the top of the mesh and the wall density in supersonic flow. Computational stability is maintained throughout the range of parameters investigated. Dissert. Abstr.

N69-16780# Harry Diamond Labs., Washington, D. C.
A DIRECT-SHADOW METHOD FOR INVESTIGATING NATURAL CONVECTION IN WATER
Reinhard R. Ulrich Aug. 1968 70 p refs
(AD-679020; HDL-TR-1408) Avail: CFSTI CSCL 20/4

A direct-shadow method was used to investigate circulations caused by natural convection in distilled water layers heated uniformly from below with depths ranging from 5 mm to 2.54 cm. The top- and side-view shadow patterns indicated changes in structure which corresponded to transitions in the heat transport rate through the fluid layer. A ray-tracing technique is described in which the relative spatial intensity distribution for light that passes through a fluid layer with a known temperature field can be constructed for any path length beyond the fluid layer. This method was used to determine the ray-distribution at various screen distances for parallel light indicent on a fluid band cell having a temperature field derived by Rayleigh. The relationship between the fluid temperature variations and the shadow-pattern light-intensity variations was established by experiments with a uniformly drifting fluid layer of 5-mm depth. These experiments showed that the relative temporal temperature variations at a point in the fluid were closely correlated with the second integral of the relative temporal light-intensity variations at a corresponding point in the shadow patterns. Author (TAB)

N69-16844# Mississippi State Univ., State College. Dept. of Aerophysics and Aerospace Engineering.
NUMERICAL SOLUTION OF THE INCOMPRESSIBLE, TWO-DIMENSIONAL, TIME-DEPENDENT NAVIER-STOKES EQUATIONS FOR A BODY OSCILLATING IN PITCH IN A MOVING FLUID
Joe E. Thompson, Jr. Oct. 1968 257 p refs
(Contract DAHC04-68-C-0003)
(AD-678611; RR-86) Avail: CFSTI CSCL 20/4

A numerical solution of the incompressible, two-dimensional, time-dependent Navier-Stokes equations, which is implicit in time as well as space, has been developed for the case of a uniform flow past a body with rectangular boundaries undergoing pitch oscillations. The Navier-Stokes equations are written in the form of the vorticity equation and the Poisson equation for the stream function, thus using the vorticity and stream function as dependent variables, rather than the velocity components and the pressure. The equations are written in a moving coordinate system fixed with respect to the oscillating body, which undergoes pitch oscillations about an arbitrary axis. Author (TAB)

N69-16905# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Aerodynamic Research Dept.
EXPERIMENTAL STUDY OF PSEUDO TRANSPIRATION AT AN ORIFICE IN RAREFIED FLOW
John A. Bartz and Robert J. Vidal Sep. 1968 23 p refs
(Contract AF 49(638)-1433)
(AD-678602; CAL-AF-2041-A-3; AFOSR-68-1927) Avail: CFSTI CSCL 20/4

An experimental investigation of the low-density orifice effect, which occurs on a body that is not in thermal equilibrium with the ambient flow, was performed with a sharp flat plate under hypersonic, rarefied flow conditions. The surface pressure, measured directly with pressure transducers mounted flush with the model surface, was as much as three times larger than the pressure measured with similar transducers mounted in a cavity and vented to the surface through an orifice. The physical origin of the effect is described and an existing semi-empirical method for predicting this effect is reviewed. This method is tested with the data to assess its accuracy, and it is found to underestimate the effect by about 20% plus or minus 20%. It appears that this discrepancy might stem from a temperature effect not included in the method. Author (TAB)

N69-16909*# Case Western Reserve Univ., Cleveland, Ohio. School of Engineering.
FILM-STABILITY IN A VERTICAL ROTATING TUBE WITH A CORE-GAS FLOW
G. S. R. Sarma, Pau-Chang Lu, and Simon Ostrach Jan. 1969 222 p refs
(Grant NGR-36-003-091)
(NASA-CR-73716; FTAS/TR-69-37) Avail: CFSTI CSCL 20D

The linear hydrodynamic stability of a thin liquid layer flowing along the inside wall of a vertical tube rotating about its axis, with a core-gas flow is examined. The basic flow under consideration is derived as the fully developed, steady, laminar, two-phase, annular flow of two immiscible, Newtonian fluids in a vertical tube rotating about its axis. The stability problem is formulated under the conditions that the liquid film is thin, the density and viscosity ratios of gas to liquid are small, and the relative pressure-gradient in the gas is of the same order as gravitational acceleration. This formulation, using the conventional normal modes procedure, results in an eigenvalue problem of 12th order, with two real eigenvalue parameters. Author

N69-16947# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

FREE SURFACE PROBLEMS IN FLUID FLOW Final Report, 1 Sep. 1966-31 Aug. 1968

A. G. Mackie Nov. 1968 8 p refs

(Grant AF-AFOSR-1194-67)

(AD-678608; AFOSR-68-2609) Avail: CFSTI CSCL 20/4

This is a final scientific report on research in the area of free surface fluid flow. Research results and references to resulting publications are presented concerning investigations of areas such as self-similar solutions of the equations governing the two-dimensional, unsteady motion of a polytropic gas, the water entry problem and generalized axially symmetric potential theory. Author (TAB)

N69-16952# Aerospace Corp., El Segundo, Calif. Lab. Operations.

SUDDEN ACCELERATION OF A LAMINAR BOUNDARY LAYER BY A MOVING BELT

A. Mager Jul. 1968 68 p refs

(Contract F04695-67-C-0158)

(AD-678956; TR-0158(3305)-2; SAMSO-TR-68-418) Avail: CFSTI CSCL 20/4

The paper suggested a method for analysis of boundary layers encountering a sudden change in boundary conditions based on a transformation into a new coordinate system which, though not appropriate for the original boundary layer, is nevertheless essential to the description of the perturbation caused by the new boundary conditions. Specifically, an incompressible, laminar boundary layer of the Falkner-Skan type is assumed to be suddenly accelerated by a belt moving in the plane of the wall at a constant speed in the downstream direction. General equations for such a flow are solved far away from, as well as close to, the location at which the boundary layer first encounters the moving belt. The results have shown that not only can the separation of the boundary layer be thus shifted infinitely far downstream, but also that a sufficiently rapid movement of the belt can produce in short distance a substantial acceleration of the flow leading to over-all frictional thrust instead of drag. As one may have intuitively expected, this last effect becomes greater the larger the belt velocity and the smaller the momentum loss of the original layer. Author (TAB)

N69-17009# General Electric Co., Philadelphia, Pa. Missile and Space Div.

A STUDY OF THE HYPERSONIC LEADING EDGE FLOW IN THE MERGED LAYER AND STRONG INTERACTION REGIMES Final Report

Richard W. Garvine Dec. 1968 49 p refs

(Contract N00014-68-C-0169)

(AD-679185) Avail: CFSTI CSCL 20/4

The problem of hypersonic flow near the leading edge of a sharp-edged body is investigated. The region of chief interest is the merged layer flow regime just upstream of the strong interaction regime. The limitations of applying continuum equations to the leading edge flow are discussed. A system of composite equations applicable to the merged layer and strong interaction flow regime is then developed systematically from the Navier-Stokes equations for the steady, planar or axi-symmetric flow of a perfect gas. Limited numerical solutions of these equations are described for the case of a sharp-edged flat plate. Owing to the presence of weak upstream influence in the problem, divergent behavior is encountered in the numerical treatment of the problem. The divergence scale is quite small, and prevents extensive calculations for the merged layer from being made. It is concluded that another means for numerical solution of the equations is required if practical computation times are to be achieved. Author (TAB)

N69-17016# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.

HEAT TRANSFER IN THE LAMINAR SUPERSONIC SEPARATED FLOW BEHIND AN AXISYMMETRICAL BACKWARD FACING STEP

Josef Rom and Arnan Seginer Jun. 1968 55 p refs

(Contract F61052-67-C-0033)

(AD-678958; TAE-82; SR-8) Avail: CFSTI CSCL 20/4

Heat transfer rates are measured in the separated and reattaching flow regions behind an axisymmetrical backward facing step on a cone-cylinder model, in the high enthalpy laminar supersonic flow in the shock tube. The variation of the local heat transfer rate, divided by the equivalent attached heat transfer rate, behind the separation point is presented at various flow conditions. Shown, also, are the variations of the maximum and average heat transfer rates as functions of Reynolds and shock Mach numbers. Local heat transfer rates are found to vary with distance behind the step and to depend on the combination of Reynolds and shock Mach numbers. The heat transfer rate increases rapidly in the reattachment region and then decreases a little in the attached flow. Both the separation minimum heat transfer rate and the reattachment peak value increase when the Reynolds number is increased and Mach number decreased simultaneously. Peak values from 0.6 to 4 times the equivalent attached values are measured. Author (TAB)

N69-17050# Army Biological Labs., Fort Detrick, Md.

COLLOQUIUM AND SYMPOSIUM ON THE PROBLEM OF TURBULENCE

A. M. Obukhov Jul. 1968 3 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), v. 31, no. 12, Dec. 1961 p 102-103

(AD-678903; TRANS-1094) Avail: CFSTI CSCL 20/4

Colloquium and symposium on the problem of turbulence-translation. TAB

N69-17073 National Lending Library for Science and Technology, Boston Spa (England).

OPTIMUM DIMENSIONING OF CYCLONES BY MEANS OF SIMPLIFIED MODEL CALCULATIONS [OPTIMALE DIMENSIONIERUNG VON ZYKLONEN MIT HILFE VEREINFACHENDER MODELLRECHNUNGEN]

H. Rumpf, K. Borho, and H. Reichert 24 Oct. 1968 28 p Transl. into ENGLISH from Russian rept. Presented at Eng. of Gas/Solid Reactions, Brighton, 1968

(NLL-Trans-68/155-(9022.4) Avail: Natl. Lending Library, Boston Spa, Engl.

The separation effect and the pressure loss of a cyclone are determined via the angular momentum conservation equation using recent theoretical and experimental results. Simplified conditions are assumed. The method applies to gas cyclones; it can be applied to liquid cyclones only if the down current is without air core and if the particle velocity in peripheral direction approaches the peripheral velocity of the flow medium. The study is limited to charges below 1 to 10 g/m^3 in which the flow conditions are essentially still those of the pure gas stream. The equations developed in the study were programmed, and all geometric parameters for dimensioning appear as independent variables on which the energy loss and the influx factor depend. The optimization condition is that the energy loss should be minimal. K.W.

N69-17118# Boeing Co., Seattle, Wash. Office of International Operations.

AN INDIRECT METHOD OF CALCULATING PLANE SUBSONIC FLOW

W. Gretler 5 Dec. 1968 15 p refs Transl. into ENGLISH from J. de Mecan. (Paris), v. 7, no. 1, Mar. 1968

(B-758) Avail: Issuing Activity

The nonlinear elliptical differential equations of plane, stationary subsonic flow are transformed at first by introduction of new variables to the Cauchy-Riemann differential equations, whence evolve differential relations between the Cartesian coordinates and the new variables. Introduction of complex variables leads to representations formally related to plane supersonic problems, which also allow a perturbation calculation. This is first made in the transformed plane. The functional relationship between local coordinates of the flow plane and the coordinates of the new plane is obtained in the series development method after solution of a system of transformed Beltrami equations. The solution, given in parametric form, has no singularities and is thus uniformly valid. Limiting solutions for incompressible and transonic flow are indicated. The method is applied to two simple examples. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N69-16106*# Geological Survey, Washington, D. C.
INFRARED SURVEY OF THE PISGAH CRATER AREA, SAN BERNARDINO COUNTY, CALIFORNIA: A GEOLOGIC INTERPRETATION
Stephen J. Gawarecki Jan. 1969 71 p refs
(NASA Order R-09-020-011)
(NASA-CR-99234; NASA-99) Avail: CFSTI CSCL 08G

Infrared imagery in the 8–14 μ band of the Pisgah Crater area has provided useful geologic information to complement data obtained from ground studies and from aerial photography. Thermal contrasts representative of those found through the diurnal cycle were acquired during three of six flight periods: at about 2000 (post-sunset), 0400 (pre-sunrise), and 1200 (midday). The largest amount of information on geologic thermal parameters from a single imaging period was obtained from the imagery flown shortly after sunset. Among the geologic features shown on imagery of one or more flight periods were basalt flow contacts where the adjacent flows differed in surface character, distribution of pyroclastics and their alluvial derivatives on the flows, collapsed lava tubes, fissured areas, detail of the Pisgah fault, zonation within Lavic dry lake, active drainage on an alluvial fan, and moist areas suggestive of ground water conditions. Author

N69-16113*# California Univ., Berkeley. School of Forestry and Conservation.
FOREST SPECIES IDENTIFICATION AND TIMBER TYPE DELINEATION ON MULTISPECTRAL PHOTOGRAPHY
Annual Progress Report
Donald T. Lauer 30 Sep. 1968 90 p refs Prepared in Cooperation with the Forest Serv., US Dept. of Agr.
(NASA Order R-09-038-002)
(NASA-CR-99184) Avail: CFSTI CSCL 02F

Research performed at the various NASA Forestry Test Sites is described, and the results obtained are reported. Within the various test sites, it was found that a skilled photointerpreter can determine major vegetation type boundaries and identify the predominant forest species on high altitude-small scale aerial photography. However, the photography must be flown to optimum specifications in terms of film, filter combination, season of year, and time of day. Analysis of photography taken over homogeneous pure stand cover types occurring within an extended study area, Flicker Ridge, indicates that (1) accurate vegetation surveys can be made without implementing expensive and time-consuming on-the-ground inventory techniques, (2) color infrared photography provides the interpreter with significantly more information on vegetative cover than panchromatic photography, and (3) color infrared photography requires approximately 25% fewer man hours of interpretation time than black-and-white photography. Author

N69-16120 Michigan Univ., Ann Arbor.
NONLINEAR ASPECTS OF THE LARGE-SCALE MOTION IN THE ATMOSPHERE
Chien-Hsiung Yang (Ph.D. Thesis) 1967 184 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-7761

Nonlinear aspects of the large-scale motion in the atmosphere are studied observationally in the energy exchanges among the harmonic components and analytically in the effects of nonlinear interactions upon the growth of baroclinic waves. In the observational study the energy exchanges arising from the horizontal advections of momentum and heat by the nondivergent component of the geostrophic motion are calculated in the region north of 20°N diagnostically from the observations of the heights of isobaric surface taken daily during the period from February, 1963 to January, 1964. In the analytical study the development of baroclinic waves superimposed upon a constant parallel flow in a rectangular region of the β-plane is investigated by including the most important nonlinear interactions. The horizontal eddy diffusion and Newtonian cooling are assumed to be the mechanism responsible for dissipation of energy. Dissert. Abstr.

N69-16170 Michigan Univ., Ann Arbor.
THE HYDROMAGNETIC STRUCTURE OF THE NEUTRAL SHEET IN THE EARTH'S MAGNETOTAIL
Patrick Michael Cassen (Ph.D. Thesis) 1967 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-7573

The self-consistent hydromagnetic structure of the neutral sheet in the Earth's magnetotail is studied. The primary concern is the physical characteristics of the magnetic field–plasma interaction. The plasma is considered to be a compressible, viscous thermally and electrically conducting fluid. Assuming that the neutral sheet may be represented, to zeroth order, by a tangential discontinuity, it is shown how the problem can be treated as that of an aligned-field boundary layer. A set of nonlinear, coupled, ordinary differential equations is derived from the governing hydromagnetic equations. The relevant parameters are discussed with particular reference to their effects on the general nature of the plasma flow. Analog solutions are obtained for the velocity, magnetic field, density, and temperature distributions within the neutral sheet. The results are discussed in the light of direct observations of the neutral sheet by artificial satellites. Dissert. Abstr.

N69-16265# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A REVIEW OF THE RESULTS OF AN INVESTIGATION OF THE PARAMETERS OF EARTH'S GRAVITATIONAL FIELD BASED ON SATELLITE TRACKING DATA
I. D. Zhongolovich 6 Dec. 1967 12 p refs Transl. into ENGLISH from Nablyudeniya Iskusstv. Sputnikov Zemli (USSR), no. 1, 1957–1962 p 25–32
(AD-678616; FTD-HT-23-1156-67) Avail: CFSTI CSCL 8/5

Optical and radiotechnical satellite tracking data allowed the elaboration of a new method for the investigation of the gravitational field of the Earth. Results which considerably enlarge our knowledge on the structure of the Earths gravitational field are given in the tables. However, only a combination of the method based on satellite tracking data together with the completion of

the world gravitational survey on the Earth surface can result in the solution of the problem essential for scientific and practical purposes. TAB

N69-16267# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RICHARDSON CRITICAL NUMBER [O KRITICHESKOM CHISLE RICHARDSONA]
A. B. Kazanskii 26 Jan. 1968 12 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, ser. Fiz. (Moscow), v. 1, no. 8, 1965 p 876–879
(AD-678615; FTD-HT-23-1053-67) Avail: CFSTI CSCL 4/1

The Richardson number was studied in the range 0-Ricr (critical) in a stably stratified surface boundary layer of the atmosphere. This work served to broaden earlier studies and included an analysis of accumulated data. The vertical gradients of the averages of the wind speed (u), temperature (T), and specific humidity of the air (Q) at a height z above the earth were studied. Author (TAB)

N69-16298 Oregon State Univ., Corvallis.
ON THE REDUCTION AND INTERPRETATION OF OCEAN-FLOOR TEMPERATURE AND HEAT FLOW DATA
Keh-Gong Shih (Ph.D. Thesis) 1968 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-6892

In this thesis, the interpretation and reduction of ocean heat flow measurements are discussed on the basis of theoretical models. The instrument effect on heat flow measurements is investigated for the case of long period measurements by studying the heat conduction along the measurement probe for both steady and unsteady state bottom temperatures. This effect is found to be unimportant. Measurement errors due to recent bottom temperature transients are studied and the possible magnitude of such errors is estimated. Moreover, effects of climatic variation on the ocean floor temperature are estimated on the basis of diffusion models. It is shown that climatic variations with periods longer than one thousand years will be unattenuated and will affect the entire ocean floor. The perturbation method is used to study the effects of an irregular topography and a variable thickness of ocean floor sediments on the heat flow. Dissert. Abstr.

N69-16307 National Lending Library for Science and Technology, Boston Spa (England).
THE USE OF THE NATURAL COMPONENTS FOR FORECASTING THE H FIELD ON 3–5 DAYS FOR EASTERN SIBERIA
A. V. Borodina 24 Jun. 1966 11 p refs Transl. into ENGLISH from Leningr., Glav. Uprav. Gidromet. Sluz., Met. Gidr. (Leningrad), no. 3, 1967 p 28–34 In ENGLISH and RUSSIAN
(NLL-M-7456-(5828.4F)) Avail: Natl Lending Library, Boston Spa, Engl.

Synoptic-statistical analysis, based on the theory of multiple correlation, is used to forecast the H_{500} pressure field over eastern Siberia. The statistical connections between the different characteristics of the atmosphere are used to form regression equations which determine the future values of these characteristics in the form of functions of some quantities pertaining to past time. In order to characterize synoptic situations by fewer parameters, the sequence of H_{500} fields for three to five days over Siberia and the Far East were resolved into natural orthogonal functions. The initial statistical set of fields was obtained by random selection from data for the winter months between 1955 and 1964. The forecast area was covered with a network of 20 stations, and the correlation matrices were computed by using the departures of the initial data from the time average for each station. Eigen values and Eigen vectors of the fields were obtained via computer program using the method of steepest descent. The results of this method compared favorably with other calculations and weather checks on the area under consideration. A.C.R.

N69-16322# Columbia Univ., Palisades, N. Y. Lamont Geological Observatory.
RESEARCH DIRECTED TOWARD THE USE OF LONG AND INTERMEDIATE PERIOD SEISMIC WAVES FOR THE IDENTIFICATION OF SEISMIC SOURCES Final Report, 1 Aug. 1964–31 Jul. 1968
Keith McCamy Sep. 1968 38 p refs
(Contract AF 19(628)-4082; ARPA Order 292)
(AD-678557; AFCRL-68-0553) Avail: CFSTI CSCL 8/11

In the period covered by this report, Lamont Geological Observatory has made significant advances towards the use of long and intermediate period seismic waves for the identification of seismic sources. Our increased understanding of many features of the seismogram has enhanced its utility in detecting and identifying small seismic events. The recently states principles of global tectonics have shed new light on the problems of world seismicity, source mechanisms and the location of seismic events. The structure and causes of seismic noise which limits the effectiveness of all detecting instruments are now understood so well that much of the noise can be predicted. A large network of long and intermediate period instruments has been operated, and new high sensitivity, broadband, low noise instruments have been developed which have proved especially effective for detecting small events. A study of the relative excitation of surface waves by earthquakes and explosions revealed it to be a powerful discriminant between two sources. The steady development of computer programs has permitted rapid and sophisticated analysis of both conventional and Large Aperture Seismic Array data. Thus many of the goals of this research have been attained and important progress has been made toward detecting and identifying seismic events. Author (TAB)

N69-16390*# Oregon State Univ., Corvallis. Agriculture Experiment Station.
THE FEASIBILITY OF INVENTORYING NATIVE VEGETATION AND RELATED RESOURCES FROM SPACE PHOTOGRAPHY
Charles E. Poulton, Barry J. Schrumpf, and Edmundo Garcia-Moya Berkeley, Calif. Forestry Remote Sensing Lab. 30 Sep. 1968 52 p refs Prepared for Dept. of Agr.
(NASA Order R-09-038-002)
(NASA-CR-99249) Avail: CFSTI CSCL 02F

Space photography taken during the Gemini IV overflight of southern Arizona is being studied to assess the appropriateness of this system of remote sensing for inventorying native vegetation and related resources. Close examination of frame S-65-34681 and experience in relating images to their vegetation and soil subjects indicate that a meaningful inventory of these resources can be accomplished through the use of space photography. A work flow chart presents ways to proceed toward small scale representation. An inventory can be obtained through strict adherence to specified mapping concepts and ecological principles as they apply to several steps in the flow chart. In this way, photo images can be delineated and identified. Production of an inventory only follows successful solution of several problems in the development of ground truth and image interpretation. Sub-sampling aerial photography was investigated as a means for solving subject discrimination problems. Image to subject relationship problems are resolved by developing a phytosociological interpretation of the vegetation that is consistent with the scale and resolution of the space photography. Author

N69-16393# Adelaide Univ. (Australia). Dept. of Physics.
SOME OBSERVATIONS OF STRATOSPHERIC DUST BY MEANS OF THE TWILIGHT SCATTERING TECHNIQUE

K. Bartusek and D. J. Gambling Dec. 1968 18 p refs
(ADP-66) Avail: CFSTI

The rate of change of the brightness of the twilight sky was measured at St. Kilda, South Australia (latitude −34° 43', longitude 138° 35') between October 1965 and February 1968. Enhanced scattering, ascribed to the presence of aerosols, was found at altitudes between 11 and 17 km. The maximum concentration of this dust layer appears to be located at the average tropopause height. There was evidence of volcanic debris from Mt. Taal (latitude 14°N, longitude 121°E) which erupted on September 28, 1965. No enhanced scattering at 80 km was observed. Author

N69-16404# Sandia Corp., Albuquerque, N. Mex.
SOME CHARACTERISTICS OF THE RECOVERY OF THE UPPER ATMOSPHERE FROM VERY-HIGH LEVELS OF EXCESS IONIZATION
Frank P. Hudson [1968] 12 p Presented at the 3d Aeronomy Conf., Urbana, Ill., 23-26 Sep. 1968
(Contract AT(29-1)-789)
(SC-DC-68-2407; CONF-680923-1) Avail: CFSTI

A calculational model involving simultaneous solution of twenty coupled differential equations has been used to determine some of the characteristics of the recovery of the upper atmosphere from very high levels of charge perturbation. The time dependence of the densities of a number of positive and negative ionic species and electrons, under a variety of initial conditions, is shown. The altitude range is from 50 to 100 km and the levels of initial ionization I_0 are selected in the range 10^{-8} to 10^{-1}. The relative importance of various electron removal processes as a function of I_0 and altitude is shown, and the contribution of negative ions as later-time sources of electrons is demonstrated. Author (NSA)

N69-16407 Chicago Univ., Ill.
A PROSPECTUS: RADAR PROBING OF ATMOSPHERIC TURBULENCE
David Atlas 8 Jul. 1968 17 p refs Sponsored in part by United Airlines Found.
(Grant NSF GA-819)
(TN-2) Avail: Issuing Activity

The major problems are discussed which need solution to advance knowledge of clear air turbulence (CAT) and the ways in which joint radar-aircraft-meteorological investigations may contribute to those solutions. The basic mechanisms responsible for the origin of CAT, its structure and detection, and means for assessing the extent to which turbulence draws energy from the general circulation or acts to transfer momentum in the atmosphere are considered. Author

N69-16421 National Lending Library for Science and Technology, Boston Spa (England).
SETTLING OF COARSE-DISPERSED AEROSOL IN THE EARTH'S BOUNDARY LAYER [OSEDANIE GRUBODISPERSNOGO AEROZOLYA NA PODSTILAYUSHCHUYU POVERKHNOST' ZEMLI]
V. F. Dunskii et al Nov. 1968 16 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 185, 1966 p 148-161
(NLL-RTS-4824) Avail: Natl. Lending Library, Boston Spa, Engl.: 3s

Results of field experiments are given on the distribution of coarse dispersed aerosol on the boundary layer of the atmosphere and on the settling of the dispersed phase on the earth's surface. Author

N69-16435# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
THE STRUCTURE OF CANOPY FLOW FIELD
Takeshi Kawatani and Robert N. Meroney Aug. 1968 134 p refs
(Contract DA-AMC-28-043-65-G20)
(AD-678591; CER67-68RNM66) Avail: CFSTI CSCL 4/2

A model study of canopy flow over high roughness elements was carried out using roughness consisting of pegs 9. cm high and 0.48 cm in diameter arranged in four patterns. The mean velocity and the turbulence intensity were measured within and above the roughness elements. Empirical expressions derived from field measurements for mean velocity profiles, turbulent velocity, and turbulence intensity were used to examine the data obtained in this model study. The logarithmic profile was adapted to analyze the data of mean velocity above the canopy. In this analysis, the friction velocity and the roughness parameter were calculated from the mean velocity profiles and related to the density of roughness elements to show the effects of roughness density on the flow field. The growth of the internal boundary layer was estimated from the mean velocity profiles and the turbulence intensity. The results of estimation were compared with semi-imperical equations. Although the coefficient of anisotropy above the canopy in this model study is larger than in the field, the model study gave data about the turbulent flow field similar to the field data. Hence, this model was verified to be suitable for the study of diffusion. Author (TAB)

N69-16447*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
X-BAND SCATTERING MEASUREMENTS OF EARTH SURFACES FROM AN AIRCRAFT
J. F. Reintjes, J. R. Sandison, J. A. Bosco, and L. W. Counts Sep. 1968 71 p refs
(Grant NsG-234-61; DSR Proj. 76343)
(NASA-CR-99213; ESL-R-370) Avail: CFSTI CSCL 17I

An airborne radar-type instrument has been used to measure the backscattering properties of Earth surfaces at three different angles of illumination. The data obtained are used in an effort to discern a relationship between the radar-backscatter characteristics with gross surface features. The magnitude of scatter coefficient and variations in its magnitude with viewing angle differ greatly for water and mountainous surfaces. Over water the scatter coefficient is high at normal incidence of the impinging electro-magnetic waves and falls off rapidly as the viewing angle departs from ninety degrees. Over mountainous areas the magnitude of scattering coefficient remains relatively constant over a 30-degree variation in viewing from 90 degrees and its value is of the order of 20 dB less than the maximum over-water value. Additional comparisons are made in the report of measurements made over farmland and desert areas. Included in the report is a detailed description of the measuring instrument. Author

N69-16461*# Department of Agriculture, Washington, D. C. Forest Service.
THE FEASIBILITY OF IDENTIFYING WILDLAND RESOURCES THROUGH THE ANALYSIS OF DIGITALLY RECORDED REMOTE SENSING DATA Annual Progress Report
Jerry D. Lent (California Univ., Berkeley) 30 Sep. 1968 134 p refs
(NASA Order R-09-038-002)
(NASA-CR-99244) Avail: CFSTI CSCL 02F

This report describes the research performed to determine the feasibility of identifying and classifying wildland terrain features through the use of digitally recorded remote sensing data. Primary emphasis during this phase has been the discussion of the rationale for using automated interpretation techniques. The pattern recognition program developed by personnel at the Laboratory for Agricultural Remote Sensing, Purdue University, is examined for its applicability to wildland terrain data. These data consist of eighteen-channel optical-mechanical line scan imagery obtained in

1966. Preliminary greyscale printouts reveal that, with accurate ground truth information, certain features show promise of being automatically identified and classified. The statistical aspects of wildland feature identification by automatic means is currently being studied. Author

N69-16473*# GCA Technology Div., GCA Corp., Bedford, Mass.
INVESTIGATION OF THE TIME VARIATION OF SPORADIC-E LAYERS Final Report
L. G. Smith, J. F. Bedinger, and E. Constantinides Oct. 1968 30 p refs
(Contract NASw-1676)
(NASA-CR-99242; GCA-TR-68-14-N) Avail: CFSTI CSCL 04A

Wind and electron density profiles have been obtained from a series of five Nike-Apache rockets launched at intervals of 90 minutes between midnight and sunrise on 22 February 1968, at Wallops Island. In addition to the irregular features normally seen in the lower E-region at night the upper part of the electron density profile shows the presence of a layer, initially at 140 km, which is blanketed by the lower region. This layer gradually descends until it merges with the lower irregular region at sunrise. Preliminary analysis of the data indicate that this upper layer is described by the current theories of redistribution of ionization by neutral winds. No such relation is found in the lower portion of the E-region. Author

N69-16504*# GCA Technology Div., GCA Corp., Bedford, Mass.
ATMOSPHERIC NITRIC OXIDE MEASUREMENT TECHNIQUES Final Report
R. O. Carpenter, C. Schuler, and J. Pressman Nov. 1968 90 p refs
(Contract NAS12-85)
(NASA-CR-86119; GCA-TR-68-18-N) Avail: CFSTI CSCL 04A

Investigation and development of a suitable laser technique for the measurement of the vertical number density distribution of neutral nitric oxide in the earth's atmosphere are discussed. Although NO represents a minor constituent of the upper atmosphere, it is believed to play a major role in the formation of the D and lower E regions of the ionosphere. In addition, the chemiluminescence reaction between NO and O may be important in the generation of the observed night airglow continuum. Finally, ion molecule reactions involving NO^+ and NO are important in determining the final steady state conditions prevailing in these ionospheric regions. Clearly, it is of prime importance to establish both the concentration and vertical distribution of this important constituent as well as its variations with time and other pertinant aeronomic parameters. On this basis, a number of experimental and theoretical investigations have been undertaken to perform this task. However, considerable uncertainties still remain concerning many quantitative aspects of this problem. Author

N69-16529 Pennsylvania State Univ., University Park.
PRESUNRISE EFFECTS DUE TO CONJUGATE REGION PHOTOELECTRONS
Man Wai Kwei (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-8714

In winter, the electron temperature at Arecibo starts to increase prior to local sunrise following illumination of the conjugate ionosphere. At this time an increase is also noticed in the 6300 Å airglow intensity. While both these effects have been attributed to photoelectron excitation from the conjugate hemisphere, a theory which would allow quantitative prediction of these two effects has hitherto been lacking. Photoelectron flux calculations were used to examine the mechanism of presunrise heating at Arecibo. Detailed analyses are made of the escaping photoelectron flux from the conjugate region, including the effect of elastic collisions with neutrals in confining the photoelectrons. Comparisons between the theoretical heat input and observed energy losses in ambient electrons are presented. Also the theoretical and measured heat fluxes are compared. Calculations were made of the enhancement in intensity of the 6300 Å airglow, and these results are compared with measurement at Haute Provence. This comparison shows that the direct excitation of the airglow by photoelectrons as previously proposed predominates over excitation by the heated ambient electrons. Dissert. Abstr.

N69-16539*# Aztec School of Languages, Inc., Acton, Mass.
AURORAE AND AIRGLOW. RESULTS OF THE RESEARCH ON THE INTERNATIONAL GEOPHYSICAL PROJECTS. COLLECTION OF ARTICLES, NO. 13
V. I. Krasovskiy ed. Washington NASA Jan. 1969 148 p refs Transl. into ENGLISH of the publ. "Polyarnyye Siyaniya i Svecheniye Nochnogo Nebe. Rezul'taty Issledovaniy Po Mezhdunarodnym Geofizicheskim Proyektam" Moscow, Nauka Press, 1967 p 1-118
(Contract NASw-1962)
(NASA-TT-F-530) Avail: CFSTI CSCL 04A

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2. SPATIAL VARIATIONS OF THE AIRGLOW IN THE AREA OF λ 5893 Å G. A. Nasyrov p 8-10 refs (See N69-16541 08-13)

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12. RELATIVE POPULATIONS OF THE UPPER VIBRATIONAL LEVELS OF $2PGN_2$ BANDS IN AURORAE AT VARIOUS LATITUDES F. K. Shuyskaya p 96-100 refs (See N69-16551 08-13)

13. OBSERVATION OF THE AURORA ON FEBRUARY 11, 1958, AT THE ROSHCHINO STATION F. K. Shuyskaya p 101-119 refs (See N69-16552 08-13)

14. DISTRIBUTION OF AURORAE AND MAGNETIC DISTURBANCES AT HIGH LATITUDES IN RELATION TO THE ASYMMETRIC SHAPE OF THE MAGNETOSPHERE Y. I. Fel'dshteyn p 120-145 refs (See N69-16553 08-13)

N69-16540*# Aztec School of Languages, Inc., Acton, Mass.
CHARACTERISTICS OF SPATIAL DISCONTINUITIES IN THE λ 5577 Å EMISSION OF ATOMIC OXYGEN IN AIRGLOW
G. A. Nasyrov *In its* Aurorae and Airglow. Collection of Articles, no. 13 Jan. 1969 p 1-7 refs (See N69-16539 08-13)
Avail: CFSTI CSCL 04A

Based on observations in Ashkhabad, the characteristics of the green line emission were studied. The most characteristic size of the patches is 60–90 km. The distribution of patch velocities has two maxima: about 75 m/sec and 150 m/sec. These velocities increase with growth in the K-index. Periodic oscillations are revealed in the intensity of the patches with periods of 5.5 and 15.5 minutes. Author

N69-16541 *# Aztec School of Languages, Inc., Acton, Mass.
SPATIAL VARIATIONS OF THE AIRGLOW IN THE AREA OF λ5893 Å
G. A. Nasyrov *In its* Aurorae and Airglow. Collection of Articles, no. 13 Jan. 1969 p 8–10 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

Measurements showed the presence of patches in the λ 5893 Å emission, with an intensity of about 100 Rayleighs and dimensions of about 100 × 20 km. The velocities of the patch movements were about 70 km/sec. The predominating directions of the movements were eastern and northern. Author

N69-16542 *# Aztec School of Languages, Inc., Acton, Mass.
AN EXAMINATION OF THE SPACE-TIME PROPERTIES OF HYDROXYL EMISSION
O. G. Taranova *In its* Aurorae and Airglow. Collection of Articles, no. 13 Jan. 1969 p 11–21 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

This paper presents data on observations of the hydroxyl emission in the spectral region 8000–12,500 Å obtained with a spectrometer. The distribution of rotational temperatures is also obtained for OH bands of different vibrational levels and for their variations during the night. The spatial patches of the rotational temperature are revealed. According to their variations, the velocities of the vertical and horizontal winds are estimated for various heights of the OH emission. Author

N69-16543 *# Aztec School of Languages, Inc., Acton, Mass.
HYDROXYL EMISSION AT HIGH LATITUDES
N. I. Fedorova *In its* Aurorae and Airglow. Collection of Articles, no. 13 Jan. 1969 p 22–41 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

This paper presents the results of systematic observations of hydroxyl emission at the Loparskaya station (ϕ = 68.3°N) during the winter periods in 1960–1963. The intensity of the hydroxyl emission at the Loparskaya station does not deviate considerably from the OH intensity at lower latitudes, and the rotation temperature is about 20–40°K higher than in the middle latitudes. During aurora displays, the intensity and the T_{rot} of the OH bands do not increase. In the winter months, the rotation temperature remains almost unchanged from year to year, and no decrease in the T_{rot} of the OH bands is observed during lower solar activity. Author

N69-16544 *# Aztec School of Languages, Inc., Acton, Mass.
CERTAIN PROPERTIES OF THE HYDROXYL EMISSION
N. N. Shefov *In its* Aurorae and Airglow. Collection of Articles, no. 13 Jan. 1969 p 42–49 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

According to the materials of observations for many years, the variations in intensity and rotational temperatures of the OH bands were revealed for periods of 27, and 29.5 days. Author

N69-16545 *# Aztec School of Languages, Inc., Acton, Mass.
SOME RESULTS OF OBSERVATIONS OF HYDROXYL EMISSION FROM THE UPPER ATMOSPHERE IN ABASTUMANI
L. M. Fishkova et al *In its* Aurorae and Airglow. Collection of Articles, no. 13 Jan. 1969 p 50–56 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

Variations in OH emission were obtained during a solar cycle. The minimum intensity for 1962–1963 had a greater amplitude than that for 1954–1955. The seasonal variations in rotational temperature have a greater amplitude for the bands from the upper vibrational levels. A study of the intensity variations in the OH bands, in relation to the zenith distance, shows that an increase in T (OH) corresponds to a lowering of the emitting layer. Author

N69-16546 *# Aztec School of Languages, Inc., Acton, Mass.
DIURNAL VARIATIONS IN HELIUM EMISSION
O. G. Taranova *In its* Aurorae and Airglow. Collection of Articles, No. 13 Jan. 1969 p 57–60 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

This paper gives a description of the reduction method of spectrophotoelectric observations of the twilight helium emission. The results of the measurements are presented. Author

N69-16547 *# Aztec School of Languages, Inc., Acton, Mass.
TWILIGHT HELIUM EMISSION AT HIGH LATITUDES
N. I. Fedorova *In its* Aurorae and Airglow. Collection of Articles, No. 13 Jan. 1969 p 61–72 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

Regular observations of the helium emission λ 10,830 Å at the Loparskaya station (ϕ=68.3°, λ=33.1°) during the winter periods in 1960–1963 showed that the helium emission is observed only in those twilight spectra which have intensities from 200 Rayleighs and less to 3000 Rayleighs. A strong helium emission, with an intensity of more than 2000 Rayleighs, is observed, as a rule, during high magnetic and solar activity, but there is not direct correlation between them. With a decrease in the solar activity from 1960 to 1963, the intensity of λ 10,830 Å did not change noticeably. During the red aurora of type A, a very intensive helium emission is always observed. Author

N69-16548 *# Aztec School of Languages, Inc., Acton, Mass.
STATISTICAL PROPERTIES OF THE HELIUM EMISSION
N. N. Shefov *In its* Aurorae and Airglow. Collection of Articles, No. 13 Jan. 1969 p 73–78 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

Statistical analyses of the data from observations of helium emission show considerable variations in the ultraviolet radiation of the Sun during a solar cycle, and with the period of 27 days. It was established that the electron fluxes with energies of about 25 eV depend on the magnetic activity. Author

N69-16549 *# Aztec School of Languages, Inc., Acton, Mass.
VARIATIONS IN THE HYDROGEN ALPHA EMISSION AND HYDROGEN DISTRIBUTION IN THE UPPER ATMOSPHERE AND THE GEOCORONA
L. M. Fishkova et al *In its* Aurorae and Airglow. Collection of Articles, No. 13 Jan. 1969 p 79–83 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

The variations in intensity of the hydrogen emission showed a maximum during the minimum of solar activity in 1962–1963. The distribution of hydrogen content at altitudes from 400 to 1300 km was calculated. It increased during the period of the minimum in the solar cycle. No concentration of H_α emission around the ecliptic was detected. Author

N69-16550*# Aztec School of Languages, Inc., Acton, Mass.
ANGULAR AND ENERGY DISTRIBUTION OF PROTONS IN AURORAE
O. L. Vaysberg *In its* Aurorae and Airglow. Collection of Articles, No. 13, Jan. 1969 p 84-95 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

Based on the profiles of the H_α line obtained by observations of aurorae at different zenith distances, calculations were made of the pitch-angle distribution and the energy spectrum of the incident protons. The calculated spectrum corresponded well with the measured spectrum in the solar wind. Author

N69-16551*# Aztec School of Languages, Inc., Acton, Mass.
RELATIVE POPULATIONS OF THE UPPER VIBRATIONAL LEVELS OF $2PGN_2$ BANDS IN AURORAE AT VARIOUS LATITUDES
F. K. Shuyskaya *In its* Aurorae and Airglow. Collection of Articles, No. 13, Jan. 1969 p 96-100 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

The observational data of different stations show that the vibrational temperatures of the $2PGN_2$ bands in aurorae are the same at different latitudes. Author

N69-16552*# Aztec School of Languages, Inc., Acton, Mass.
OBSERVATION OF THE AURORA ON FEBRUARY 11, 1958, AT THE ROSHCHINO STATION
F. K. Shuyskaya *In its* Aurorae and Airglow. Collection of Articles, no. 13, Jan. 1969 p 101-119 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

This paper discusses the results of observations of the aurora display on February 11, 1958, with an "All-Sky" camera and a patrol spectrograph (dispersion ≈ 320 Å/mm, spectral range λ 3900 Å-λ 6600 Å). It was determined that, during the period from 1:30 to 2:30, the spectrum of the aurora contained very intensive forbidden oxygen lines λλ6364, 6300, 5577 Å and $1NGN_2$ + bands. The total energy of the aurora in the visible region of the spectrum during that period reached approximately $2 \cdot 10^{19}$ erg/sec. The number of N_2 + ions in the vertical atmospheric column was $3 \cdot 10^{11}$ particles/cm^3. The maximum intensity was observed during the moments of deep negative bays in the horizontal component of the Earth's magnetic field. Author

N69-16553*# Aztec School of Languages, Inc., Acton Mass.
DISTRIBUTION OF AURORAE AND MAGNETIC DISTURBANCES AT HIGH LATITUDES IN RELATION TO THE ASYMMETRIC SHAPE OF THE MAGNETOSPHERE
Ya. I. Fel'dshteyn *In its* Aurorae and Airglow. Collection of Articles, no. 13, Jan. 1969 p 120-145 refs (See N69-16539 06-13)
Avail: CFSTI CSCL 04A

On the basis of the materials from observations of aurorae at the zenith, with the network of "All-Sky" cameras, the distribution of the aurorae is shown in relation to the latitude and the local time, for magnetically quiet ($K_p \leq 1$) and magnetically disturbed periods ($K_p \leq 5$). The results of a statistical analysis of the aurorae distribution were supplemented with synoptic maps of the aurorae distribution at fixed moments of Universal Time on December 13 and 23, 1957. The concept of an oval current zone located at higher latitudes in the day and at lower altitudes during the night correlates well with the ratio between values at the stations in Tikhaya Bay and Tromsö, as well as with the distribution of magnetic activity at Canadian stations. Author

N69-16580*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF SYNCHRONOUS OBSERVATIONS OF SATELLITES IN SPACE GEODESY
B. A. Firago *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38, 14 Feb. 1968 p 25-29 refs (See N69-16574 06-14)
Avail: CFSTI

A method of solving direct and indirect problems of space geodesy with the aid of synchronous observations is considered. Equalizing of observed data and coordinates of base stations are realized by consecutive application of the least squares method to the system of equations of sighting lines. Systematic errors of moments of time and geodetic coordinates of individual stations can be detected and excluded. Author

N69-16589*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NATIONAL REPORT OF THE SOVIET COMMITTEE ON GEOPHYSICS IN CONNECTION WITH THE "INTERNATIONAL YEAR OF THE QUIET SUN" DURING THE PERIOD 1964-1966 [NATSIONAL'NYY OTCHET SOVETSKOGO GEOFIZICHESKOGO KOMITETA PO PROYEKTU "MEZHDUNARODNYY GOD SPOKOYNOGO SOLNTSA" ZA PERIOD 1964-1966]
23 Jan. 1968 44 p Transl. into ENGLISH from Russian
(AD-678883; FTD-HT-23-1457-67) Avail: CFSTI CSCL 3/1

In the period 1964-1966 the USSR carried out studies on all aspects of the program of the IYQS: (1) universal days; (2) meteorology; (3) geomagnetism; (4) polar aurorae and luminescence of the sky; (5) the ionosphere and meteors; (6) solar activity; (7) cosmic rays; (8) investigations of cosmic space. Below we present brief data on the execution of the observation program and on preliminary scientific results with respect to the first seven categories. In addition, information is presented in connection with the Comet category, included in the program of the IYQS on the initiative of Soviet scientists, and there are also reports of the B2 Data Collection Center containing data on the entire geophysical electromagnetic complex, as well as reports from the Center on Comet Data. Author (TAB)

N69-16597*# California Inst. of Tech., Pasadena.
CHARACTERISTICS OF THE DIRUNALLY VARYING ELECTRON FLUX NEAR THE POLAR CAP
Martin H. Israel and Rochus E. Vogt [1968] 30 p refs
(Grant NGL-05-002-007)
(NASA-CR-99214) Avail: CFSTI CSCL 04A

Characteristics of the dirunally varying electron fluxes observed near the polar cap are reported. The discussion is based upon balloon observations near Ft. Churchill, Manitoba in 1967 of both the electron flux vertically incident on the atmosphere and the electron splash albedo. Also measured was an electron splash albedo flux below 100 Mev equal to the flux of electrons below 100 Mev incident on the atmosphere during daytime. The observed diurnal variation of the flux of electrons with energies ≤ 100 Mev is consistent with geomagnetic cutoff variations calculated for models of the magnetosphere. A geomagnetic cutoff rigidity of ≤ 17 MV was deduced for the nighttime interval and between 70 and 110 MV for the daytime interval at an invariant latitude near 68° in 1967. Author

N69-16645*# Battelle Memorial Inst., Columbus, Ohio.
SATELLITE APPLICATIONS TO MARINE GEODESY
A. G. Mourad, N. A. Frazier, J. H. Holdahl, F. W. Someroski, and A. T. Hooper Washington NASA Jan. 1969 157 p refs
(Contract NASr-100(11))
(NASA-CR-1253) Avail: CFSTI CSCL 08E

The potential use of satellites for enhancing positioning capabilities and for marine geodetic control was studied. Requirements, needs, currently available major positioning systems, and the GEOS II capabilities are identified in this report. Applications

are considered in geophysics and geology, hydrographic and bathymetric charting and mapping, and physical oceanography. Also discussed are relevant aspects of tracking, acquisition, localization, identification, equipment testing, calibration, and evaluation.
K.W.

N69-16768 Arkansas Univ., Fayetteville.
GEOCHEMICAL AND ISOTOPIC STUDIES OF HYDROTHERMAL GASES AND WATERS
Bobby Dean Gunter (Ph.D. Thesis) 1968 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-9658

Field analyses were made on 103 gas samples from Yellowstone National Park on 25 gas samples from Lassen Volcanic National Park by gas chromatography. Six gases, CO_2, H_2, N_2, O_2, Ar, and CH_4, were identified in the field samples. Laboratory analyses of several large samples yielded ethane in about 60 percent of the features, and other low molecular weight aliphatic compounds, both saturated and unsaturated, were identified in one sample. The non-reactive gases nitrogen and argon are functionally related by a Rayleigh distillation process in this study. The distillation relationship also applies to the non-reactive gases for data in the literature. This is interpreted to indicate that the bulk of the oxygen, nitrogen, and inert gases in these systems is of atmospheric origin. Isotope equilibrium temperatures calculated from the carbon isotope ratios do not agree with those calculated from hydrogen isotope ratios.
Dissert. Abstr.

N69-16800# RAND Corp., Santa Monica, Calif.
VARIATIONS IN THE GEOMAGNETIC FIELD AND IN THE RATE OF THE EARTH'S ROTATION
R. H. Ball, Anne B. Kahle, and E. H. Vestine Oct. 1968 33 p refs
(Contract F44620-67-C-0045)
(AD-678866; RM-5717-PR) Avail: CFSTI CSCL 8/14

Vestine and Kahle, in a previous paper, found a strong correlation between motion of the geomagnetic eccentric dipole and changes in the earths rotation rate, as inferred from astronomical data. This correlation suggested that the irregular change in length of day was compensated by a change in angular momentum of the outer core which is related to the eccentric dipole motion. New data are used to improve these curves, and the significance of the results is further analyzed. The observed lag in phase between the mantle and magnetically inferred core motion can be explained by diffusion of the magnetic signal through a conducting mantle, which conversely gives an independent estimate of the mantle conductivity. Results of numerical calculations for the phase lag and associated distortions of the apparent eccentric dipole motion are presented.
Author (TAB)

N69-16801# White Sands Missile Range, N. Mex. Atmospheric Sciences Research Office.
THE SYNOPTIC EVENTS OF THE STRATOSPHERIC WARMING OF DECEMBER 1967-JANUARY 1968
Ben H. Williams and Bruce T. Miers Sep. 1968 52 p refs
(AD-679024; ECOM-5216) Avail: CFSTI CSCL 4/1

Large-scale synoptic changes associated with the major midwinter stratospheric warming of December 1967 - January 1968 are described. Constant altitude maps at 40 and 50 km that were derived primarily from meteorological rocket data are presented. Mean temperature maps for the atmospheric layer between 40 and 50 km were constructed from the pressure and wind distributions of the constant height charts and the hypsometric formula. The synoptic events illustrated in this paper have demonstrated that warm air was observed at high latitudes in the upper stratosphere prior to any other indication of a stratospheric warming; stratospheric circulation changes associated with the major warming began several days after the warm air was first observed; the stratosphere was baroclinically unstable during the warming; the largest temperature changes occurred near 30 km and amounted to as much as 70C; the meridional temperature gradients indicated the passage of warm air to the north of the midlatitude meteorological rocket stations; and retrogression of the Aleutian High occurred.
Author (TAB)

N69-16804# Washington Univ., Seattle, Wash. Dept. of Atmospheric Sciences.
DYNAMIC STRUCTURE OF THE LOWER ATMOSPHERE
J. A. Businger, A. S. Frisch, and K. H. Bergman Ft. Huachuca, Ariz. ECOM Aug. 1968 26 p
(Grants DA-AMC-28-043-67-G6; DA-AMC-36-039-63-G1)
(AD-679142; ECOM-67G6-F) Avail: CFSTI CSCL 4/1

The document contains reports on the dynamic structure of the lower atmosphere.
TAB

N69-16825# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
SLIGHT ERRORS IN 2ND-ORDER TRIANGULATION [OSHIBKI VISIROVANIYA V TRIANGULYATSII 2 KLASSA]
V. T. Pryakho Nov. 1968 13 p ref Transl. into ENGLISH from Geod. i Kartografiya (Moscow), no. 5, 1966 p 28-33
(AD-679420; ACIC-TC-1459) Avail: CFSTI CSCL 8/2

The main errors during the measurement of angles in the second order triangulation are those arising because of external surroundings and instrumental and personal errors. The standard error of sighting, caused by the error in matching the aiming instrument with the sighting target, depends on the error resulting from the shortcomings of observers eye and from the deficiencies of the telescope as well as on the error in the performance of the theodolite's alidade.
Author (TAB)

N69-16826# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
NEAR FIELDS AND ANTIPODAL FIELDS IN THE TERRESTRIAL EARTH-TO-IONOSPHERE WAVE GUIDE
Janis Galejs Nov. 1968 36 p refs
(AD-679164; RR-565) Avail: CFSTI CSCL 20/14

Near fields of a vertical electric dipole are expressed as a series of zonal harmonics or as a summation of wave-guide modes. These representations are compared with dipole fields on a conducting ground plane and with field calculations using the method of images or ray theory. The series of zonal harmonics and the mode sum provide nearly identical near fields; their difference characterizes the contribution of so-called branch-cut waves and is negligible in the present computational model. In the near field range, the method of images gives the simplest field representation for ELF; for VLF, a useful approximation is provided by combining the ground wave and a single sky wave. At the upper wave-guide boundary, the radial electric fields are finite; but the other field components vanish when approaching the source axis. The field components exhibit similar variations also when approaching the antipode of the source.
Author (TAB)

N69-16846# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
AXIAL SYMMETRY OF LINEAR STRUCTURAL ELEMENTS OF THE EARTH'S CRUST [OSEVAYA SIMMETRIYA LINEYNYKH STRUKTURNYKH ELEMENTOV ZEMNOIKORY]
A. V. Dolitskii [1968] 12 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR Ser. Geol. (Moscow), v. 177, no. 1, 1967 p 159-162
(AD-679421; ACIC-TC-1431) Avail: CFSTI CSCL 8/7

The strikes of foldings and faults characterize the non-uniformity in the structure of the terrestrial crust and the

anistropy of its stability. The exposure of regularities in spatial distribution of these linear structural elements of the earth's crust would make it possible to approach the study of its deformation in a new way. In particular it is important to know if the fractures in the earths crust had originated in the beginning of its development and regenerated later during various epochs of folding or if new fractures have been formed during each epoch. The answer to this question may be found in the investigation of all linear structural elements regardless of their age and scale on lands and, as far as possible in oceans. This problem is approached by selecting linear elements depicted on tectonic maps of various continents, especially on 1:2500000-1:5000000 tectonic maps of Europe and Asia. Any blanks on the map can be solved by constructing spectrums of linear elements observed in the vicinity of these points, thus providing a basis for further study on this problem. More detailed investigation is explained herein.
Author (TAB)

N69-16858*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
STUDIES OF ATMOSPHERIC WATER VAPOR BY MEANS OF PASSIVE MICROWAVE TECHNIQUES
Norman E. Gaut (Ph.D. Thesis) 20 Dec. 1968 106 p refs Revised
(Grant NGL-22-009-016; Contract DA-28-043-AMC-02536(E))
(NASA-CR-73652; TR-467) Avail: CFSTI CSCL 04A

Expressions describing the absorption by water vapor near its two lowest rotational spectral lines (22.235 GHz and 183.310 GHz) were developed. These expressions are used to investigate the absorption from model and real atmospheres. Absorption measurements taken near the lower frequency line are compared with computed spectra based on data from simultaneous nearby radiosonde ascents. Comparable spectra occur only on days of high static stability. The spectral spike which excessive stratospheric water vapor might produce was searched for, but not found, in the observed absorption data. Under reasonable assumptions about the distribution of water vapor in the stratosphere, this result follows. A method for determining integrated water vapor using zenith opacity at several frequencies has been derived and evaluated. Estimations within ±5% of the true values are consistently obtainable. Finally, the statistical scheme for inverting spectral data in order to obtain the vertical distribution of water vapor was evaluated for 34 radiosondes from Boston and vicinity. The procedure is shown to be stable against a variety of errors in the data and statistical assumptions.
Author

N69-16882# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
DETERMINATION OF PARTICLE SIZE AND CONCENTRATION FROM PHOTOMETER AND SECCHI DISC MEASUREMENTS
Jerome Williams Nov. 1968 17 p refs
(Contract Nonr-4010(11))
(AD-679169; TR-48; REF-68-18) Avail: CFSTI CSCL 8/10

The mathematical model developed in a previous report is extended to allow for direct calculation of particle size and concentration from optical data. The optical parameters utilized are such that black and white Secchi Discs coupled with a submarine filter photometer are the only instruments required to determine equivalent optical radii and particle concentration values.
Author (TAB)

N69-16883# Office of Naval Intelligence, Washington, D. C. Translation Div.
THE FIRST STAGE OF THE STUDY OF ANTARCTICA FROM THE MID-EIGHTEENTH TO THE END OF THE NINETEENTH CENTURY [PRVYY ETAP IZUCHENIYA ANTARKTIKI S SERE-DINY 18 DO KONTSA 19 VEKA]
B. V. Tkachenko ed. 20 Aug. 1968 9 p Transl. into ENGLISH from Tr. Nauchn.-issled. Inst. Geol. Arktiki (Leningrad), v. 95, no. 1, 1957 p 9–14
(AD-679300; NIC-Trans-2654(B)) Avail: CFSTI CSCL 8/6

The article describes voyages and expeditions in the Antarctic regions from the mid-eighteenth to the end of the nineteenth century.
TAB

N69-16887# Office of Naval Intelligence, Washington, D. C. Translation Div.
GEOLOGICAL STRUCTURE ON THE CENTRAL PORTION OF QUEEN MAUD LAND MOUNTAINS IN EASTERN ANTARCTICA (PRELIMINARY DATA) [GEOLOGICHESKOYE STROYENIYE TSENTRAL'NOY CHASTI GOR ZEMLI KOROLEVY MOD V VOSTOCHNOY ANTARCTIDE (PREDVARITEL'NYYE DANNYYE)]
M. G. Ravich et al. 15 Aug. 1968 51 p refs Transl. into ENGLISH from Russian
(AD-679305; NIC-Trans-2670) Avail: CFSTI CSCL 8/7

Geological structure on the central portion of Queen Maud land mountains in Eastern Antarctica (preliminary data).
TAB

N69-16908*# Geological Survey, Menlo Park, Calif.
POST-EARTHQUAKE INFRARED IMAGERY, PARKFIELD-CHOLAME, CALIFORNIA EARTHQUAKES OF JUNE–AUGUST, 1966
Robert D. Brown, Jr. Jan. 1969 52 p refs
(NASA Order R-09-020-011)
(NASA-CR-73737; NASA-139) Avail: CFSTI CSCL 08K

An assessment is made of the infrared imagery obtained over an active segment of the San Andreas fault during a period of continuing earthquake shocks and measurable fault displacement. The investigation described is part of a U.S. Geological Survey program to test and evaluate geologic applications of a number of recently developed remote sensor techniques in use by the National Aeronautics and Space Administration. It was undertaken to determine whether detectable thermal anomalies, marked by 8 to 13 μ infrared radiation, accompany active faulting. Despite generally favorable conditions and high-quality imagery, no anomalies of the type sought were detected. However, the imagery does illustrate very clearly a number of features that help locate the San Andreas fault, and it shows both the limitations and advantages of this remote sensing device. Details are given on the geologic conditions under which the imagery was obtained, the kinds of thermal anomalies that were sought, and the results shown by the imagery. It also briefly examines some vegetation contrasts that are thought to be responsible for some of the fault-line anomalies evident in the imagery.
Author

N69-16921*# Stanford Research Inst., Menlo Park, Calif.
RESEARCH RELATED TO MEASUREMENTS OF ATOMIC SPECIES IN THE EARTH'S UPPER ATMOSPHERE Quarterly Status Report
Bernard J. Wood 1 Dec. 1968 14 p refs
(Contract NASr-49(30))
(NASA-CR-73740; QSR-6) Avail: CFSTI CSCL 04A

The kinetics and mechanisms of interaction of oxygen atoms with solid surfaces of engineering interest under conditions similar to those encountered in the upper atmosphere are investigated. The experimental approach employs a reaction vessel in which the total gas pressure and the entering flux of oxygen atoms are held constant. The rate of interaction of oxygen atoms with a metal surface is evaluated by observing the diminution in atom flux at the outlet of the vessel when a specimen of the material of interest is inserted into the reactor. Measurements were obtained on recombination efficiency of gold, sorption rate of oxygen atoms on gold, desorption rate of sorbed oxygen at 25°C, and the sticking coefficient of carbon monoxide.
Author

N69-16927# Office of Naval Intelligence, Washington, D. C. Translation Div.
THE PRINCIPAL FEATURES OF THE GEOLOGICAL STRUCTURE OF ANTARCTICA [OSNOVNYYE CHERTY GEOLOGICHESKOY STRUKTURY ANTARKTIDY]
L. V. Klimov 16 Sep. 1968 28 p refs Transl. into ENGLISH from Inform. Byull. Sov. Antarkt. Eksped. (Leningrad), no. 65, 1967 p 30-43
(AD-679325; NIC-Trans-2699) Avail: CFSTI CSCL 8/7

A combination of Gondwanian and Pacific geostructures is the outstanding feature in the area of the general structure of Antarctica's tectonosphere. It predominates in a Gondwanian type platform, resembling those of Africa, South America, Australia and India. Similarly to them, the Antarctic platform is distinguished, on one hand, by the heterogeneity of its substructure, which has been subjected to complex transformations over large areas, not only during the pre-Cambrian, but also during the early Paleozoic era, and on the other hand, by the peculiar formational composition of the middle Paleozoic - lower Mesozoic deposits of the covering strata, almost wholly continental in character and largely carboniferous, with numerous remnants of Gondwanian flora. Author (TAB)

N69-16933# Environmental Science Services Administration, Boulder, Colo. Space Disturbances Lab.
OBSERVATIONS OF ACOUSTIC WAVES IN THE IONOSPHERE FOLLOWING NUCLEAR EXPLOSIONS
Donald M. Baker Oct. 1968 54 p refs
(AD-678877; ERL-89-SDL-5) Avail: SOD $.55 CSCL 18/3

During 1961 and 1962 wavelike disturbances were observed in the ionosphere above the United States following seventy-five nuclear explosions in the atmosphere. The disturbances, which were detected at 150 to 200 km, had characteristic periods of about 1 min and speeds of about 300 m/s. In general an explosion must have a yield equivalent to 1 megaton of TNT or greater to generate a disturbance detectable at 7000 km from the source. The periods and propagation speeds of the ionospheric disturbances are essentially the same as those observed on the ground with microbarographs. The ionospheric disturbances are interpreted as manifestations of imperfectly ducted acoustic waves. A method is developed for relating the ionospheric-disturbance observations to the pressure perturbation in the neutral atmosphere. For one specific event (30 October 1962) an upper limit to the relative pressure perturbation at 190 km is found to be 13 percent. A complete catalog of the nuclear explosions detected is given. Author (TAB)

N69-16953# Aerospace Corp., El Segundo, Calif. Technical Operations.
A STUDY OF ATMOSPHERIC HEATING APPLIED TO THE PHENOMENON OF GEOMAGNETIC HEATING
G. E. Thomas and B. K. Ching Jun. 1968 46 p refs
(Contract F04695-67-C-0158)
(AD-679111; TR-0158(3110-01)-5; SAMSO-TR-68-423) Avail: CFSTI CSCL 4/1

The well-known impulsive increase in satellite drag acceleration accompanying world-wide geomagnetic activity is interpreted to be the consequence of heating and expansion of the neutral upper atmospheric gas. For an assumed one-dimensional heating that is not attached to the geomagnetic field lines, the dominant mode of heat transport is molecular heat conduction above about 100 km. Using approximate analytic Green's functions for the temperature on isobaric surfaces, one can determine the atmospheric properties from the hydrostatic law. Solutions for the time-varying density from a variety of heating distributions are compared with satellite drag observations. Average values of the energy input are given as a function of geomagnetic activity. In addition, the comparison of density time-lag predictions with the observed 6-hr time delays following peak geomagnetic disturbance gives information on how the heating is distributed in time and space. Author (TAB)

N69-16964# Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
POST-DOCTORAL PROGRAM IN SEISMOLOGY Annual Report, 1 Jul. 1967-30 Jun. 1968
Frank Press, M. Nafi Toksoz, Keiiti Aki, Paul E. Green, and Edward J. Kelly, Jr. Jun. 1968 116 p refs *Its* Seismology-2
(Contract AF 49(638)-1763; ARPA Order 292-67)
(AD-679104) Avail: CFSTI CSCL 8/11

The research efforts of the research associates supported by this program are described. These studies are divided into two groups: I. Continental size arrays and their application, and II. Theoretical seismograms and earth structure. A continental size array can be realized by considering individual seismic stations as array elements. The theoretical seismograms for P and S waves are computed for a model of point source in layered medium and matched with observed records. Author (TAB)

N69-16968# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ATMOSPHERIC IMPLICATIONS OF PREDISSOCIATION IN N_2
Robert D. Hudson and Virginia L. Carter Sep. 1968 12 p refs
(Contract F04701-68-C-0200)
(AD-679112; TR-0200(9260-01)-1; SAMSO-TR-68-427) Avail: CFSTI CSCL 4/1

Analysis of the half-widths of the individual rotational absorption lines of N2 at high resolution (delta lambda = 0.038A) indicates that all of the lines between 800 and 1000A are broadened by predissociation. This implies that photo-dissociation of atmospheric N2 by solar radiation may be as much as 10,000 times greater than assumed previously and may, indeed, contribute significantly to the over-all rate of production of atomic nitrogen in the upper atmosphere. Author (TAB)

N69-16986 National Lending Library for Science and Technology, Boston Spa (England).
THE GENERAL DYNAMICS OF THE ATMOSPHERE AND THE THEORY OF CLIMATE
M. E. Svic et al 18 Oct. 1968 14 p refs Transl. into ENGLISH from Gl. Uprav. Gidromet. Sluz. (Leningrad), 1967 p 11-18
(NLL-M-544(9022.551) Avail: Natl. Lending Library, Boston Spa, Engl.

An overview is presented on the studies conducted since 1920 by the Soviet Geophysical Observatory on the relationships between atmospheric processes, dynamic meteorology, and thermohydrodynamics. Particular attention is given to investigations on the general dynamics of the atmosphere, the theory of climate, and general circulation of the atmosphere. A bibliography is included. M.G.J.

N69-16988*# Geological Survey, Flagstaff, Ariz.
GEOLOGIC EVALUATION OF RADAR IMAGERY, CALIENTE AND TEMBLOR RANGES, SOUTHERN CALIFORNIA
Edward W. Wolfe Jan. 1969 23 p refs
(NASA Order R-09-020-011)
(NASA-CR-73738; NASA-133) Avail: CFSTI CSCL 08G

The K-band radar imagery was flown along northwest-southeast flight lines in the Caliente-Temblor Range area of Southern California. In one pass, the plane flew along the southwest edge of the San Joaquin valley with the radar scanner looking southwest toward the Temblor Range and Carrizo Plain. In a second pass, the plane flew along the northeastern flank of the Caliente Range with the radar scanner looking northeast so as to include part of the Caliente Range, the Carrizo Plain, and part of the Temblor Range in the image. It was found that the prime factor controlling brightness in the Carrizo Plain radar images is slope orientation. Surfaces that face the scanner at high angles are bright; those that face the scanner at low angles are represented by intermediate tones; those that face away from the scanner are black

in the radar images. Differences in radar reflection related to slope orientation are most distinct in the like-polarized images. It was also noted that microtopography exerts a subordinate effect that is most distinct in the cross-polarized images. M.G.J.

N69-17004# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
PROBLEMS OF AMBIGUITY INVOLVED WITH THE UTILIZATION OF THE MIE THEORY IN PARTICLE SIZE DETERMINATION
Jerome Williams Nov. 1968 19 p refs
(Contract Nonr-4010(11))
(AD-679170; TR-49; Ref-68-19) Avail: CFSTI CSCL 8/10

A commonly used method for determining particle size in a naturally occurring hydrosol is to use relative scattering values at different wavelengths in conjunction with the Mie theory of light scattering. It is shown that there are at least two regions of ambiguity where identical scattering values will predict different particle sizes. Data are shown to illustrate this point and it is concluded that an additional method must be used to resolve the ambiguity. Author (TAB)

N69-17005# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
A MATHEMATICAL MODEL FOR THE DESCRIPTION OF THE OPTICAL PROPERTIES OF TURBID WATER IN TERMS OF SUSPENDED PARTICLE SIZE AND CONCENTRATION
Jerome Williams Nov. 1968 21 p refs
(Contract Nonr-4010(11))
(AD-679168; TR-47; Ref-68-17) Avail: CFSTI CSCL 8/10

A mathematical model is developed for a hypothetical suspensoid of particulate matter in water. The assumptions are made that the particles are homogeneously distributed throughout the medium, the particles all are the same size, and they are all spherical in shape. The resulting expressions relate the particle radius and concentration to extinction coefficient, beam attenuance coefficient, and upwelling light. A logarithiconormal distribution is developed and it is concluded that this model does not supply enough data to determine the statistical parameters of this distribution. Author (TAB)

N69-17017# Environmental Data Service, Silver Spring, Md.
SOME ASPECTS OF THE ATMOSPHERIC CIRCULATION OVER THE ALASKA AREA Interim Report, 1 Jan. 1967-31 Mar. 1968
P. Putnins Aug. 1968 65 p refs
(AD-679048; IR-3) Avail: Issuing Activity CSCL 4/1

Data were extracted from monthly 500-mb contour maps of the German Weather Service to compute zonal and meridional indices for the area limited by the 55th and 75th parallel between 130 degrees W and 180 degrees W. The harmonic analysis of the data provided information on the values of the amplitudes of the various harmonics for specified sub-sections of the above region. The behavior of surface pressure gradients over Alaska, the annual variations of temperature, and the changes in circulation patterns as reflected in the displacement of pressure centers at 500 mb were examined to determine a physical explanation of the behavior of the zonal and meridional indices. Author (TAB)

N69-17027# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
LABORATORY STUDIES OF PROPAGATION OF MAGNETIC DISTURBANCES IN THE MAGNETOSPHERE Final Report, 1 Jun. 1966-30 Apr. 1968
Joseph V. Gore, Donald H. McKay, Sebastian Y. K. Tam, and Tudor W. Johnston Jul. 1968 91 p refs
(Contract AF 19(628)-6128)
(AD-679216; RCE-Res.-Rept-7-901-67; AFCRL-68-0415) Avail: CFSTI CSCL 4/1

Scaling factors for laboratory experiments relevant to magnetospheric disturbances are discussed, with particular application to a terrella-plasma stream experiment. Owing to the limited success of this terrella experiment, a program for laboratory study of whistler waves in a large magnetoplasma was conceived. Future work along these lines is likely to yield very interesting results for plane wave behaviour and whistler antenna characteristics. Author (TAB)

N69-17035*# Volt Information Sciences, Inc., Washington, D. C.
ESTIMATE OF THE RATE OF CHARGED PARTICLE VERTICAL TRANSFER IN THE OUTER PART OF THE IONOSPHERE F2-REGION
A. Muradov et al NASA 30 Jan. 1968 10 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 8, no. 6, 1968 p 1039-1044
(NASA-CR-73714; ST-AI-PF-10804) Avail: CFSTI CSCL 04A

A method for determining the effective rate of charged particle vertical transfer in the ionosphere is presented, taking into account the vertical velocity gradients. Analytical expressions are obtained for the vertical ionization transfer rate for various forms of distribution and numerical estimates are made for this transfer rate in the upper part of the F 2 region under near settled conditions. For altitudes less than 350 km, it is shown that ambipolar diffuson with a velocity on the order of several μ sec cannot assure the vertical transfer rates necessary for agreement of experimental curves with presently available data on the structural parameters of the upper atmosphere, on solar shortwave radiation, and on ionization recombination processes. Joint examination of ambipolar diffusion and plasma flows arising from the wind motions of the upper atmosphere reveals vertical transfer values that are in agreement with those estimated by the experimental profiles. Author

N69-17120 National Lending Library for Science and Technology, Boston Spa (England).
ON HAZARDOUS CONDITIONS OF ATMOSPHERIC POLLUTION FROM INDUSTRIAL SOURCES
M. E. Berljand [1968] 23 p refs Transl. into ENGLISH from Glav. Geof. Observy. (Leningrad), v. 185, 1966 p 15-25 In ENGLISH and RUSSIAN
(NLL-M-7455-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.

This study deals with the initial ascent of fumes issuing from chimneys and the dependence upon the coefficient of turbulent exchange and the temperature gradient in the atmosphere. The conditions are indicated in which the initial ascent of the fumes may be small, in the event of a temperature inversion. In cases in which such conditions are accompanied by small wind speeds, particularly hazardous situations arise, in which the surface concentration of the fumes reaches its highest value. Author

N69-17188# Joint Publications Research Service, Washington, D. C.
STUDIES OF THE UPPER ATMOSPHERE WITH ROCKETS AND SATELLITES
M. G. Kondratyev *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 16-74 refs (See N69-17187 08-34)
Avail: CFSTI

A review of results obtained from U.S.S.R. rocket and satellite investigations of the upper atmosphere is presented. The relative advantages of various techniques of gathering data are treated, as well as observations on the distribution of atmospheric composition;

vertical distribution of density and temperature; and electron and ion distributions and variations, including those governed by solar activity. Included are data gathered by geophysical and meteorological rockets and satellites. A.C.R.

N69-17189# Joint Publications Research Service, Washington, D. C.
SOME IONOSPHERIC STUDIES BASED ON ANALYSIS OF RADIO WAVES EMANATING FROM ARTIFICIAL EARTH SATELLITES
Ya. L. Alpert *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 75-111 refs (See N69-17187 06-34)
Avail: CFSTI

The development of techniques and equipment used in the U.S.S.R. for ionospheric study using radio wave emissions from earth satellites is outlined. The types of data that may be extracted from such observations, the development of theoretical methods, and the scientific results of individual experiments are included. Particular emphasis is placed on the study of the vertical variation of electron concentration in the ionosphere by analysis of amplitude signals obtained from the satellites. The various methods of analyzing these signals, from the early techniques to the more refined instrumentation used aboard recent Cosmos and Elektron satellites, are described. In addition, it is emphasized that a deepening understanding of the various phenomena requires continuing reexamination of the raw data obtained from these launchings. A.C.R.

N69-17192# Joint Publications Research Service, Washington, D. C.
STUDIES OF THE MAGNETIC FIELDS OF THE EARTH AND PLANETS
Sh. Sh. Dolginov et al. *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 188-273 refs (See N69-17187 06-34)
Avail: CFSTI

The development of scientific research in the field of geomagnetism, as applied to satellite and spacecraft programs in the U.S.S.R., is discussed; and the contributions made by experimental data obtained with magnetic and radiation instruments aboard these vehicles are outlined. The flights enabled the first study of the geomagnetic field over an extensive area of the earth and allowed calculations to establish an accurate and detailed model. The field was studied at various distances in high latitudes on the earth's daytime and nighttime sides and compared with theoretically computed values. It was established experimentally that the field extends to the moon on the nighttime side. In addition, a number of field variations were discovered as related to the mechanism of storm development. A morphological model of auroras was also made possible. Lunar studies laid the basis for investigations of the magnetism of planets and of the solar system. A.C.R.

N69-17197# Joint Publications Research Service, Washington, D. C.
OPTICAL OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES AND THEIR IMPORTANCE FOR GEODESY AND GEOPHYSICS
In its USSR Achievements in Space Res. 24 Jan. 1969 p 423-480 refs (See N69-17187 06-34)
Avail: CFSTI

Optical data gathered by Soviet earth satellites during the last ten years, including visual, photographic, and synchronous visual and photographic observations, are summarized. The importance of these observations in solving problems in atmospheric physics, geophysics, and geodesy is emphasized, as well as the need for international cooperation in collecting the data on a world wide basis. A.C.R.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N69-16108*# Northwestern Univ., Evanston, Ill. Dept. of Geography.
SIDE-LOOKING RADAR IN URBAN RESEARCH: A CASE STUDY
Eric G. Moore Jan. 1969 27 p refs
(NASA Order R-09-020-024; Contract USGS-14-08-0001-10654)
(NASA-CR-99233; NASA-138) Avail: CFSTI CSCL 14E

The main part of the paper examines the capabilities of AN/APQ-97 radar imagery of Chicago in both HH and HV polarization modes with regard to the compilation of a land use inventory. The main conclusions are (1) the linear elements of the transportation network are clearly defined; the HV proves to be more useful than the HH as high returns from adjacent buildings on the latter prevent accurate interpretation; (2) the gross patterns of industrial, residential and open space land use are identified although it is not possible to map local boundaries of different land use types in detail; and (3) attempts to identify commercial land proved to be surprisingly unsuccessful, the cardinal effect introducing considerable difficulties into the recognition process. Finally, it is stressed that it is necessary to undertake similar experiments using other radar systems. Author

N69-16233# ARO, Inc., Arnold Air Force Station, Tenn.
PERFORMANCE OF A DYNAMICALLY COMPENSATED LOAD CELL FORCE MEASUREMENT SYSTEM Final Report, Aug.-Oct. 1967
F. L. Crosswy and H. T. Kalb Arnold Eng. Develop. Center Nov. 1968 33 p refs
(Contract F40600-69-C-0001)
(AD-678520; AEDC-TR-68-211) Avail: CFSTI CSCL 14/2

The report presents a theoretical description and an experimental evaluation of a dynamically compensated load cell force measurement system. Electronic compensation techniques were used to eliminate load cell signal distortions caused by large amplitude load cell base (thrust butt) motions and other structural transient responses of the force measurement device. The force measurement device was subjected to severe impact forces up to 4600 lb peak force with force rise times of 300 microsec and total force durations of 900 microsec. Load cell base motions caused by these impact forces approached 0.25 in., and the load cell signal was badly distorted. However, application of the compensation techniques eliminated these distortions, and dynamic force measurements could then be made regardless of load cell base motion and the structural response of the rest of the force measurement device. Author (TAB)

N69-16255*# Kansas Univ., Lawrence. Dept. of Geography.
THE UTILITY OF RADAR AND OTHER REMOTE SENSORS IN THEMATIC LAND USE MAPPING FROM SPACECRAFT Annual Report, 1 Mar. 1967-30 Apr. 1968
David S. Simonett 1 May 1968 120 p refs
(NASA Order R-09-020-024; Contract USGS-14-08-0001-10848)
(NASA-CR-99239; NASA-140) Avail: CFSTI CSCL 14E

Studies are described which seek to evaluate for different climatic environments in the United States and Puerto Rico the various ways in which spacecraft- and aircraft-borne radar imagery, color and false color photography, high-resolution television, and other

sensing and enhancing techniques can be used to complement and supplement one another for producing thematic land use maps. Investigations at field study sites and work with the Image Discrimination Enhancement Combination and Sampling system (IDECS) are summarized. Detailed reports are presented on four specific studies: (1) an evaluation of classified radar imagery of landform regions obtained by flight over Puerto Rico; (2) an urban land use study of Lawrence, Kansas, using K band radar; (3) a correlation of population and radar-derived areas of 19 urban locations; and (4) radar imagery observations of geomorphology and land use in a part of the Wasatch Range, Utah. K.W.

N69-16382*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND PERFORMANCE OF FLUERIC SHOCK POSITION SENSOR FOR A MIXED-COMPRESSION SUPERSONIC INLET
William S. Griffin Washington Jan. 1969 57 p refs
(NASA-TM-X-1733) Avail: CFSTI CSCL 01C

A flueric sensor for normal shock position has been developed and tested on a Mach 2.5 mixed compression axisymmetric supersonic inlet. The sensor detects shock position by sensing the most rearward minimum in static wall pressure profile. Static and dynamic responses of the sensor were evaluated. Static response agreed relatively well with theory, but dynamic response indicated further improvements to the sensor as well as suggestions for improving the sensor's dynamic performance. Author

N69-16389*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THERMALLY ACTUATED GIMBAL Final Report, 21 Feb. – 21 Aug. 1967
1 Sep. 1967 53 p refs
(Contract NAS5-10329)
(NASA-CR-99247; DOC-67SD4358) Avail: CFSTI CSCL 13I

The gimbal has been completed and shipped; the pertinent design, manufacture, and test data are described and discussed. The gimbal performed quite satisfactorily and generally as expected. This novel, frictionless, smoothly operating gimbal, requiring no earth supplied power, has characteristics very useful for performing many functions in space with high reliability and long life. Orienting spacecraft payloads, such as cameras and antennas, providing attitude trim for gravity gradient stabilized vehicles, or with a gravity gradient or other anchor, providing torque against which flywheels can be unloaded, are some possibilities. Author

N69-16432# Sandia Corp., Albuquerque, N. Mex.
FLUID POWER APPLIED TO HAZARDOUS LOCATION TEST EQUIPMENT
R. M. Oelsner Nov. 1967 40 p Presented at the 3d Ind. Application of Fluidics Seminar, Milwaukee
(Contract AT(29-1)-789)
(SC-DC-66-2428; CONF-670451-1) Avail: CFSTI

Severe restrictions are imposed on the designers of test equipment when the equipment is to be used in a hazardous location. Test equipment designers have combined fluid and electric power in a single automatic test system that meets the requirements of hazardous location use. Author (NSA)

N69-16443 Ohio State Univ., Columbus.
HORIZON-CONTROLLED ANALYTICAL STRIP TRIANGULATION
Simha Weismann (Ph.D. Thesis) 1967 178 p
Avail: Microfilm: HC $8.20/Microfilm $3.00 Order No. 68-8894

The horizon camera is one of the currently available auxiliary instruments which provide the values of the mapping camera tilt components (ϕ and ω) at the moment of exposure. A new method of deducing the absolute values of these orientation parameters from the horizon pictures has been established. If definite points can be observed on the horizon pictures, the swing (κ) can also be determined. In this study, the effect of κ on the determination of ϕ and ω in the case that no definite points are observable is investigated. It was found that if κ is known to within $\pm$ 4 g or if it may be assumed that the value of κ does not exceed 4 g it is possible, at least geometrically, to determine the tilt components with an accuracy of $\pm$ 2 c with the available equipment. It was further demonstrated that from a geometrical point of view, a wide angle horizon camera will enable the determination of both ϕ and ω from every single horizon picture, with practically the same degree of accuracy. The data are a powerful means of controlling the unavoidable error accumulation and propagation which is encountered in aerial triangulation, particularly in long strips with sparse ground control points. Dissert. Abstr.

N69-16486*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY INSTRUMENTS
In its Supporting Res. and Advanced Development 31 Oct. 1968 p 133–143 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 22A

Design criteria for the folding rotating cup anemometer are defined as (1) performance (range and threshold sensitivity of the anemometer in a Mars atmosphere), and (2) compatibility (size, weight, sterilizability, and survival under impact). The instrument must also survive sterilization, be capable of surviving 2500 g of impact acceleration, and fit within a cylindrical volume 1 in. in height and 1.5 in. in diameter. An analytical model was constructed to determine the effects of anemometer geometry on performance. Results showed that a collapsible model would be required; to satisfy the performance criteria, the anemometer would need to be larger than the 1.5 in. diam cyclindrical volume in the lander. An overview is presented on parametric studies of instruments for measuring wind velocity at the surface of Mars. Preliminary results indicate that the tracer-type is the only relatively compact and simple instrument that yields both magnitude and direction. M.G.J.

N69-16562# Forsvarets Forskningsanstalt, Stockholm (Sweden).
EFFECT OF SOME DEVELOPERS ON BLACK-WHITE PHOTOGRAPHIC EMULSIONS [INVERKAN AV OLIKA FRAMKALLARE PA NAGRA SVART-VITA FOTOGRAFISKA EMULSIONER]
S. Larsson and C. H. Agren Sep. 1967 13 p In SWEDISH
(FOA-2-C-2188-51) Avail: CFSTI

The variations in the measured sensitivity during development of black-white photographic film in different developers were examined. A number of commonly used films and developers were evaluated. The results are presented in tables and graphs. Author

N69-16574# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BULLETIN OF THE STATIONS FOR OPTICAL OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES, NO. 38
14 Feb. 1968 69 p refs Transl. of the Publ. "Byulleten' Stantsiy Opticheskogo Nablyudeniya Iskusstvennykh. No. 38" Moscow, Astron. Sobet, Akad. Nauk SSSR, 1964 p 1–61
(AD-679382; FTD-MT-24-179-67) Avail: CFSTI CSCL 22/3

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8. DEVIATION OF THE APPARENT SATELLITE ORBIT FROM THE ARC OF A GREAT CIRCLE G. A. Leykin p 33–36 (See N69-16582 06-30)

9. PRELIMINARY ORBITAL ELEMENTS OF ARTIFICIAL EARTH SATELLITES COSMOS 2, COSMOS 3, AND COSMOS 5 G. A. Chebotarev et al p 37–39 ref (See N69-16583 06-30)

10. PRELIMINARY MEAN ORBITAL ELEMENTS OF THE CABIN OF THE FIRST SOVIET SPACE SHIP (1960 ι_2) FOR JANUARY–JUNE 1963 G. A. Chebotarev et al p 40–41 (See N69-16584 06-30)

11. RESULTS OF PHOTOGRAPHIC OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES M. V. Bratiychuk et al p 42–56 (See N69-16585 06-14)

N69-16575# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENT OF PHOTOGRAPHING FLARE-UP OF A FLASH BULB ON THE BACKGROUND OF STARS

A. M. Lozinskiy et al *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38 14 Feb. 1968 p 1–5 (See N69-16574 06-14)

Avail: CFSTI

The photographing of a pulse light source against a stellar background is described. Rough estimates were made of the burst power required to form measurable images on photographs obtained by various cameras, and the accuracy of flash coordinate determinations was measured. The spherical coordinates of flash images obtained by various cameras were also compared, as well as comparisons of working conditions for cameras set up on parallactic and azimuth supports. Author

N69-16576# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMININGTHE DISTORTION AND FOCAL DISTANCE FOR THE NAFA-3s/25 OBJECTIVES AND A CAMERA WITH MOVING FILM

A. G. Kirichenko et al *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38 14 Feb. 1968 p 8–9 refs (See N69-16574 06-14)

Avail: CFSTI

Distortion of camera objectives was investigated in order to determine the suitability of the KPP and NAFA-3s/25 cameras for astrometric operations. Zenith photographs were obtained with good point images in the center of the photograph. Stars by which the distortion was determined were selected at a distance of 8–11° from the optical center for the NAFA-3s/25 camera and 5–15° for the KPP camera. The average distance between reference stars was 3–5°. From the analysis, it was determined that the value of the coefficient of distortion is not symmetric relative to the optical center. Author

N69-16577# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF A CAMERA WITH MOVING FILM

I. V. Shvalagin *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38 14 Feb. 1968 p 10–16 refs (See N69-16574 06-14)

Avail: CFSTI

Work was carried out for the purpose of studying a camera with moving film. A series of parallel photos was obtained by the NAFA-3s and KPP cameras. An evaluation was made of the accuracy of artificial earth satellite positions by photos on the KPP camera. Author

N69-16578# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A NEW NETWORK OF BINOCULAR LINES

V. A. Merkushev *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38 14 Feb. 1968 p 17–22 refs (See N69-16574 06-14)

Avail: CFSTI

The proposed special network of lines allows exclusion of gross errors (misses) in the determination of time, an accurate orientation of circles and the passage of satellites near the center of the field of view of the telescope. Author

N69-16579# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A VIEW-FINDER FOR ARTIFICIAL EARTH SATELLITE ON THE BASE OF A TELESCOPE AT-1

L. A. Panaiotov *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38 14 Feb. 1968 p 23–24 (See N69-16574 06-14)

Avail: CFSTI

The telescope AT-1 is altered in such a way that the mirror, fastened on the objective, can turn around the optical axis within defined limits. When the telescope is arranged along the apparent orbit of a satellite, by swinging the mirror it is possible to examine an area considerably exceeding the field of sight of the telescope. Author

N69-16585# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESULTS OF PHOTOGRAPHIC OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES

M. V. Bratiychuk et al *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38 14 Feb. 1968 p 42–56 (See N69-16574 06-14)

Avail: CFSTI

Results of photographic satellite observations in 1962 are tabulated. Author

N69-16639# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INSTRUMENT FOR INVESTIGATION OF THE LUMINESCENCE PROPERTIES OF CRYSTAL PHOSPHORS

B. T. Plachenov et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 184–187 (See N69-16610 06-34)

Avail: CFSTI

Details are given on vacuum chambers for investigating the luminescence properties of crystal phosphors. Construction, mechanism, and time required for preparatory operations are also discussed. Author

N69-16650*# Arizona Univ., Tucson. Field Emission and Space Systems Lab.

DETECTION TECHNIQUES FOR TENUOUS PLANETARY ATMOSPHERES Semiannual Report, 1 Jul.–31 Dec. 1968

Stuart A. Hoenig 31 Dec. 1968 18 p refs
(Grants NsG-458; NGL-03-002-019)
(NASA-CR-99237; SAR-11) Avail: CFSTI CSCL 14B

An automatic test system that permits testing of thin films under controlled conditions was constructed. Slides being tested are exposed to oxygen and then illuminated with ultraviolet light in the presence of an electric field gradient. Changes in the zinc oxide resistance are recorded as a function of time, which allows the measurement of oxygen absorbed and desorbed. Heat of reaction of carbon monoxide on hot palladium is being studied as a function of temperature, and ion emission from hot palladium is being studied by mass spectrometry. F.O.S.

N69-18655*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEVELOPMENT OF A WELD QUALITY MONITOR
J. G. Etzel and J. A. Munford Dec. 1968 14 p refs
(NASA-TM-X-63437; X-284-68-490) Avail: CFSTI CSCL 13H

An investigation was performed to develop a nondestructive method of evaluating cross-wire resistance welded joints used in electronic packaging. Mechanical strength and reproducibility of strength were determined for several alloy combinations. Data indicated that an optimum degree of embedment exists for each combination of materials. The development of an electromechanical device is described. This device automatically measures and displays the embedment of each welded joint, and locks out the welding machine if the embedment value is not within preset upper and lower limits. Author

N69-18658* Marshall Labs., Torrance, Calif.
OGO-E-16 SEARCH COIL MAGNETOMETER
Robert J. Nahabit 1967 281 p Prepared for JPL
(Contracts NAS7-100; JPL-951142)
(NASA-CR-73639) Avail: CFSTI CSCL 08N

The OGO-E triaxial search coil magnetometer was designed to measure geomagnetic and interplanetary field fluctuations in the frequency range of less than .01 Hz to above 1000 Hz. The search coil sensor, a critically dampened inductor, consists of 100,000 turns of wire wound on a nickel-steel laminated core. The basic sensitivity of the sensor is approximately 10 microvolts per gamma/per hertz. A low noise dc preamplifier with a high input impedance (10^9 ohms), low input capacity (10 picofarads), and a gain of one hundred is mounted near the sensors in a boom mounted experiment package of the spacecraft. The main electronics assembly located in the main body of the spacecraft, further amplifies the data from each preamplifier, performs a triaxial spectrum analysis, and generates seven commutated outputs per axis, each a measure of the energy in a given frequency band. Other functions provided by the main assembly are (1) real time data, (2) wideband FMdata, (3) in-flight calibration, (4) gain state data, and (5) operating power conversion and regulation. Author

N69-18670*# Honeywell Inc., Minneapolis, Minn. Aerospace Div.
THE DESIGN AND BUILD OF A GAS BEARING GYROSCOPE POSSESSING HIGH-G AND STERILIZATION CAPABILITY AND UTILIZING A LOW-POWER GAS BEARING SPINMOTOR AND HIGH-FREQUENCY PUMP Final Report
J. M. Bremer 31 Oct. 1968 54 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951559)
(NASA-CR-73647; FR-20660-FR1) Avail: CFSTI CSCL 17G

The program was completed with the shipment of one model gyroscope which satisfied the four major design goals. The high G and sterilization capabilities were verified by test results, and the spinmotor required 3.5 W running power, well below the 4.0 W contract requirement. In addition, the ability to build a spinmotor requiring less than 3.0 W was concurrently demonstrated. The fluid pump operated at 490 Hz, against the requirement of 400 Hz. The ability to withstand environmental exposures having been easily demonstrated, the resultant gyro represents a high grade inertial sensor capable of application to space navigation missions. Several adjustments were indicated to improve future units but had no substantial impact on the unit performance. These are: (1) elimination or improvement of the SMRD winding; (2) improved balance pan; and (3) adjustment of pump frequency to 400 Hz. A.C.R.

N69-18686 Oklahoma State Univ., Stillwater.
CONSTRUCTION AND ANALYSIS OF A LONG WAVELENGTH INTEGRATING SPHERE REFLECTOMETER
Roger Allen Williams (Ph.D. Thesis) 1967 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-8525

This thesis was concerned with the design, construction, and analysis of an integrating sphere reflectometer capable of determining the reflectance of samples irradiated with near-infrared and infrared energy. Various materials believed to exhibit high reflectance at long wavelengths were tested, and quenched sulfur was chosen as the sphere coating. The coating was then checked for uniformity and specularity. An error analysis was performed and the reflectance of selected samples was measured. The reflectometer, as finally developed, is capable of determining the total monochromatic directional reflectance of samples at wavelengths up to 9.5 microns. Dissert. Abstr.

N69-18693*# ARO, Inc., Arnold Air Force Station, Tenn.
HOLOGRAPHIC TECHNIQUES FOR THE STUDY OF DYNAMIC PARTICLE FIELDS Final Report, Jul. 1967–Jun. 1968
J. D. Trolinger, R. A. Belz, and W. M. Farmer Arnold Eng. Develop. Center Nov. 1968 28 p refs
(Contract F40600-69-C-0001)
(AD-678858; AEDC-TR-68-215) Avail: CFSTI CSCL 14/5

A brief review of the techniques of small-particle holography is presented. These results are extended in an elementary way to show that multiple-exposure holography can be used to study the dynamic properties of particle fields. Experimental techniques for performing such a study are then described. Finally, as a typical example, a multiple-exposure hologram of an aerosol is presented with a portion of the data extracted from it. The hologram exhibits a vast amount of information including the determination of the velocity field, density field, size distribution, flow structure, and diffusion rate. Author (TAB)

N69-18694*# ARO, Inc., Arnold Air Force Station, Tenn.
DYNAMIC COMPENSATION AND FORCE CALIBRATION TECHNIQUES FOR A STATIC AND DYNAMIC THRUST MEASUREMENT SYSTEM Final Report, Jun.–Aug. 1967
F. L. Crosswy and H. T. Kalb Arnold Eng. Develop. Center Nov. 1968 46 p refs
(Contract F40600-69-C-0001)
(AD-678857; AEDC-TR-68-202) Avail: CFSTI CSCL 14/2

An electrodynamic actuator and a solenoid-driven impact device were used separately for dynamic force excitation of an experimental thrust stand. Electronic compensation techniques were used to eliminate load cell signal distortions caused by the dynamic-force-induced transient response characteristics of the thrust stand structure. It was determined that proper compensation circuit adjustments could be made when using either the electronically and mechanically simple impact device or the more complex actuator. For the conditions of this particular study, identical dynamic force measurement accuracies were possible following either of two procedures, (1) dynamic time domain force calibration with the electrodynamic actuator or (2) dynamic compensation adjustments with dynamic force excitation furnished by the impact device followed by a static deadweight force calibration. Author (TAB)

N69-16738*# General Precision, Inc., Wayne, N. J. Kearfott Systems Div.
C702543 ALPHA 3 BALL BEARING GYROSCOPE MOTOR STERILIZATION PROGRAM. Final Report
15 Dec. 1968 38 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952019)
(NASA-CR-73607) Avail: CFSTI CSCL 17G

This report is concerned with a program to evaluate the heat sterilization capabilities of C702543 ALPHA 3 ball bearing gyroscope motor. The program was divided into two phases. The first phase deals with heat sterilization of the motor piece parts and subassemblies. The primary intent of the first phase was to detect any adverse temperature effects at the subassembly level that might be overlooked on the completed motor. The second phase dealt with the effects of heat sterilization on motor performance and life.The ethylene oxide decontamination requirement on the assembly level was eliminated in the interest of cost economy and the fact that the effects of the heat sterilization cycle were what was important, and the temperature requirement was loosened since the available temperature chambers were not within ±1°C accuracy. Before and after heat sterilization, visual, mechanical, electrical and chemical tests were performed to analyze the effects of high temperature on the motor. Author

N69-16822# Ballistic Research Labs., Aberdeen Proving Ground, Md.
VACUUM SYSTEM CONTROLLER
Donald G. McCoy Nov. 1968 16 p
(AD-679041; BRL-TN-1706) Avail: CFSTI CSCL 13/11

This report describes an instrument which has been developed at the Ballistic Research Laboratories (BRL) to control, monitor, and safeguard an ultrahigh vacuum pumping station. The basic pumping station to be controlled consists of a mechanical forepump, a vacuum solenoid valve in the foreline, a diffusion pump, and a water control solenoid. Author (TAB)

N69-16824# Army Edgewood Arsenal, Md. Nuclear Defense Lab.
CRITICAL CURRENT CHARACTERISTICS OF SUPER-CONDUCTING THIN FILM PARTICLE DETECTORS
John C. Miklosz, Jr. Aug. 1968 55 p refs
(AD-679027; NDL-TR-111) Avail: CFSTI CSCL 18/4

A brief review of the experimental and theoretical work of Spiel and Boom and of Sullivan on superconducting nuclear particle detectors is presented. Their thermal diffusion model has been improved and solutions for the dynamic behavior of thermal spikes in thin superconducting films have been obtained so that the treatment of the critical current characteristics of the detectors in the absence of joule heating is now substantially complete. It appears that some important features of the behavior of thermal spikes in thin films cannot be understood on the basis of classical thermal diffusion calculations alone. The applicability of the thermal diffusion model is considered and the effects which may make the approach inadequate are discussed. Author (TAB)

N69-16869*# Marshall Labs., Torrance, Calif.
ENGINEERING REPORT: OGO-F-22 SEARCH COIL MAGNETOMETER
Richard Entenmann 26 Jan. 1968 348 p Prepared for JPL
(Contracts NAS7-100, JPL-951630)
(NASA-CR-73646) Avail: CFSTI CSCL 08N

The OGO-F triaxial search coil magnetometer was designed to measure geomagnetic and interplanetary field fluxuations in the frequency range of less than .01 Hz to above 1000 Hz. The search coil sensor, a critically dampened inductor, consists of 100,000 turns of wire wound on a nickel-steel laminated core. The basic sensitivity of the sensor is approximately 10 microvolts per gamma/per Hertz (Hz). A low noise dc preamplifier with a high input impedance (10^9 ohms), low input capacity (10 picofarads), and a gain of 100 is located within the sensor housings which are boom mounted experiments on the spacecraft. The main electronics assembly located in the main body of the spacecraft, further amplifies the data from each preamplifier, performs a triaxial spectrum analysis, and generates seven commutated outputs per axis, each a measure of the energy in a given frequency band. Other functions provided by the main assembly are (1) real time data, (2) wideband FM data, (3) in-flight calibration, (4) gain state data, and (5) operating power conversion and regulation. Author

N69-16897 National Lending Library for Space and Technology, Boston Spa (England).
PROBLEMS IN DESIGNING INTEGRATING PHOTOMETERS AND AN EI-1 PULSED EXPOSURE METER [VOPROSY RASCHETA INTEGRIRUYUSHCHIKH FOTOMETROV I IMPUL'SNYI EKSPOZIMETR EI-1]
V. G. Baryshnikov Nov. 1968 11 p refs Transl. into ENGLISH from Svetotekhnika (Moscow), v. 16, no. 6, 1966 p 17–21
(NLL-RTS-4571) Avail: Natl. Lending Library, Boston Spa, Engl.: 12s 6d

In view of the need for a uniform approach to quantitative estimation of the measuring capabilities of photoelectric instruments, an analysis is presented of the sensitivity and error in integrating photometers. The results of the analysis are used in calculating photometer parameters. The design and construction of the EI-1 pulsed exposure meter are also included, as well as its basic technical characteristics. A.C.R.

N69-16993# Naval Ammunition Depot, Crane, Ind.
SENSING HEAD CALIBRATION DATA 'SUPER MAPI' SYSTEM
Ronald J. Stovall Sep. 1968 24 p refs
(AD-679159; NAD-CR-RDTR-117) Avail: CFSTI CSCL 19/1

A description is given of the procedures used in the original calibration of the sensing heads for the large tower MAPI System, (Super MAPI). A method for the interpretation of flare candlepower from field data is also given in addition to information on sensing head location, cell loading, and electrical wiring. Author (TAB)

N69-17013*# Houston Univ., Tex. Wave Propagation Lab.
PROBABLE DEVIATIONS IN ALTITUDE READING GIVEN BY THE LM ALTIMETER FOR THE MOST ROUGH SURFACE ALONG A CERTAIN GIVEN TRAJECTORY
A. Tong and H. S. Hayre Nov. 1967 9 p refs
(Contract NAS9-6760)
(NASA-CR-73818; TR-67-20) Avail: CFSTI CSCL 22B

The spectrum of the backscattered energy for the frequency modulated altimeter is calculated by approximating the ratio of the detected altitude to the actual altitude from target range variations versus target surface conditions. Results show that the percent deviation of the altitude reading from the actual varies considerably from 79% to 30% corresponding to angles of incidence of 0° (vertical incidence) to 60° degrees. A close examination of these results indicates the variation to be within ± 10% for look angles of 0, 5°, 10°, 20°, 25°, and 30°; deviation increases to + 203% at a 60° angle of incidence. G.G.

N69-17039 National Lending Library for Science and Technology, Boston Spa (England)
STRAIN MEASUREMENT WITH STRAIN GAUGES AT HIGH TEMPERATURES

C. Rohrbach and K. Knublauch 27 Nov. 1968 26 p refs Transl. into ENGLISH from Materialpruef. (Germany), v. 10, Apr. 1968 p 105–115
(NLL-CE-Trans-4971-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.

The apparent strains of high temperature strain gauges caused by structural changes, thermal strains, reaction on the structural member, insulation resistance, corrosion and creep, as well as their k-factor and hysteresis are measured and interpreted on commercial gauges and on gauges made by the authors. The most important characteristics are summarized in graphs. After describing the handling, circuitry, compensation and calibration factors, a general assessment of the high temperature method is made, comparing it with the low temperature method. Author

N69-17049*# Marshall Research and Development Corp., Burlington, Mass.
DESIGN AND DEVELOPMENT OF AN ISOLATION SYSTEM FOR THE ST124-M3 INERTIAL PLATFORM Final Report
Harold V. Hamilton 2 Aug. 1968 46 p refs
(Contract NAS8-20887)
(NASA-CR-98229; MRAD-200F) Avail: CFSTI CSCL 17G

The design and testing of the vibration isolation system with associated support mounting bracket for the inertial platform for Saturn 1B/5 flight missions are presented. Design details are given on the four spring packages, eight rotary viscous dampers, and the rigid magnesium base which mates the Saturn instrumentation unit mounting pads. The spring package stiffness was determined in both compression and shear, and the damping rate adjustments are described. Static tests to determine deflections and returnability, and horizontal and vertical vibration tests were also performed. It was concluded that all major technical objectives were satisfactorily accomplished. N.E.N.

N69-17086# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
THE DESIGN OF AN OPTIMUM BEAM TRANSMITTANCE METER
Jerome Williams Nov. 1968 16 p
(Contract Nonr-4010(11))
(AD-679167; TR-46, REF-68-16) Avail: CFSTI CSCL 20/6

The optical system of a standard beam transmittance meter (alpha meter) is examined in a simplified manner to determine the effects of instrument design on readings. Nine instrument parameters are examined and it is found that even under ideal conditions the apparent transmittance, as determined by a conventional device, is related to these instrument parameters. A dual beam design is suggested which appears to allow optical measurements to be made which are independent of instrument size and configuration. Author (TAB)

N69-17099*# Bell Aerosystems Co., Cleveland, Ohio.
[PROGRESS ON ACCELEROMETER DEVELOPMENT] Quarterly Report
15 Nov. 1968 29 p Prepared for JPL
(Contracts NAS7-100; JPL-951492)
(NASA-CR-73605; Rept-80007-031) Avail: CFSTI CSCL 22B

During this period one accelerometer had entered into the thermal sterilization period, while another was readied for initial testing prior to sterilization. The other accelerometers are nearing completion. Preliminary test results indicate excellent scale factor stability. All accelerometers contain pendulums cured at 300°F to increase the head distortion temperature of the spring joint epoxy to 370°F which should reduce the null bias shifting. The techniques of laser beam welding the proofmass assembly were developed in three basic steps. Welding schedules were established from test results of welded specimens. The first two proofmass assemblies to be welded by the laser method were experimental vehicles in the effort to isolate the source of null bias shifts observed on a standard Model 7 instrument after exposure to sterilization temperature. Modifications of the design will be necessary to reduce the constrainment current from approximately 100 ma. Author

N69-17132# United Kingdom Atomic Energy Authority, Harwell (England).
SMALL COMPUTER USED AS A MULTI-CHANNEL ANALYSER
A. Lewis Jul. 1968 8 p refs
(AERE-R-5844) Avail: Issuing Activity

A 2000 channel pulse height analyzer with 18-bit count capacity per channel is described. The hardware comprises a PDP-8 computer (4K–12-bit words) with DEC-tape, a control panel with switches and lamps to simulate a conventional analyzer, and uses computer independent peripherals (Prototype IANUS modules). The system is intended to work with Harwell 2000 Series nuclear counting equipment. Author (NSA)

N69-17150# Atomic Energy Commission Research Establishment, Riso (Denmark). Electronics Dept.
AUTOMATIC POTENTIOMETER SETTING PROGRAM FOR THE ANALOGUE COMPUTER EAI 680
Chr. Suusgaard and K. Soee Hoejberg Jun. 1968 12 p
(RISO-M-767; R-21-68; RISO-8-15-H) Avail: Issuing Activity

The program described is used for automatic setting of potentiometers in the analog computer EAI 680 by means of a paper tape via the PDP 8 digital computer and interface equipment. NSA

N69-17155# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.
SCINTILLATION SUM-COINCIDENCE GAMMA SPECTROMETER [STSINTILLYATSIONNYI GAMMA-SPEKTROMETER SLOZHENII-SOVPADENII]
L. S. Danelyan, B. V. Efimov, and S. K. Sotnikov 1967 24 p refs In RUSSIAN
(IAE-1457) Avail: CFSTI

A scintillation gamma spectrometer made of two sodium iodide crystals designed on the sum-coincidence principle is described. A detailed description is given of the electronic circuit and of the method of measuring low-intensity partial gamma transitions at individual neutron resonances. Author (NSA)

N69-17181# Vanderbilt Univ., Nashville, Tenn. School of Medicine.
EXPERIMENTAL EVALUATION OF MOTION CHARACTERISTICS OF A SCANNER TRANSPORT SYSTEM
J. Erickson, C. Kramer, J. Watts, and J. Wallace 15 Oct. 1968 29 p
(ORO-2401-25) Avail: CFSTI

Analysis of a two-crystal rectilinear radioisotope scanner constructed in a low-level counting facility was performed using three independent methods. The results of each analysis are discussed separately and a comparison presented. The first type of analysis was carried out by measuring the transients on acceleration from rest with the scanner by use of a tachometer attached to judicially chosen points on the scanner. The second method of analysis employed an optical lever system and provided a semiquantitative measurement of the magnitude of steady state oscillations. NSA

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N69-18104*# Kaman Aircraft Corp., Bloomfield, Conn.
THE BOSSLER COUPLING
R. J. Mayerjak and R. B. Bossler, Jr. Washington NASA Jan. 1969 119 p refs
(Contract NASw-1554)
(NASA-CR-1241; KAMAN-R-741) Avail: CFSTI CSCL 13I

A flexible drive-shaft coupling which is suitable for any level of power transmission is reported. This report presents the results of an investigation of the mechanical characteristics of the couplings. The investigation included analyses and tests. Simplified coupling analysis methods, parameter studies, and design guidelines were developed. The test areas include torsion, stiffness, strain, fatigue, constancy of velocity, critical speed, and balancing. The tests substantiated the analyses for predicting internal forces and moments, steady and alternating stress, bending and change-of-length stiffness, critical speeds, and the effects of unbalance. The coupling has unusual capability for accommodating combined axial motion, misalignment, and torque. The coupling can survive shock-torque greatly in excess of ultimate continuous torque and transient misalignments over three times the design continuous operating angle. Author

N69-16197*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF ORIENTATION AND THE PRESENCE OF SURFACE ACTIVE MATERIALS ON THE FRICTION, DEFORMATION AND WEAR OF ALUMINUM
Donald A. Buckley Washington Jan. 1969 25 p refs
(NASA-TN-D-4994) Avail: CFSTI CSCL 20K

Sliding friction experiments were conducted on single crystal and polycrystalline aluminum surfaces. The influence of the following on friction, deformation and wear were determined: (1) orientation of single crystals and textured polycrystalline sheet, (2) liquid metal embrittlement, (3) surface active organics, and (4) alloying with silver. Results indicate that friction and wear of aluminum is highly anisotropic. With single crystals, friction and wear are sensitive both to atomic plane and crystallographic direction of sliding. The presence of embrittling liquid metals on the surface of aluminum was found to reduce surface deformation during sliding. The presence of organic acids and alcohols were found to increase the deformability of oxidized aluminum surfaces. Author

N69-16299 National Lending Library for Science and Technology, Boston Spa (England).
THE USE OF ULTRASONIC TESTING METHOD FOR THE INSPECTION AND ACCEPTANCE OF WELDS
R. Trumphaller 18 Oct. 1968 30 p refs Transl. into ENGLISH from Schweissen Schneiden (Duesseldorf), v. 18, no. 6, 1968 p 1-12
(NLL-CE-TRANS-4852-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.

Despite the fact that ultrasonic testing based on the pulsed-echo method has been in practical use for a number of years it is seldom specified for the acceptance testing of welds on a contract basis. The reason for this is to be found in the fact that no specifications exist for assessing welds on the evidence of ultrasonic testing. Any agreement on such specifications requires that ultrasonic testing procedures shall be largely standardized. An attempt is made to show, in the form of examples of tests and evaluation guide lines, that agreements of this kind are possible. The object of this is to provide a basis for discussion of codes of assessment having general validity. Author

N69-16352# ARO, Inc., Arnold Air Force Station, Tenn.
AN INVESTIGATION OF EJECTOR SYSTEMS USING VERY LARGE DIFFUSERS Final Report, Dec. 1965-Jun. 1968
R. D. Herron Arnold Eng. Develop. Center Nov. 1968 57 p refs
(Contract F40600-69-C-0001)
(AD-678522; AEDC-TR-68-216) Avail: CFSTI CSCL 14/2

An experimental investigation was conducted to determine the characteristics of ejector systems using very large cylindrical diffusers. Tests were conducted with nitrogen, carbon dioxide, and helium gases in systems having diffuser cross section to nozzle throat area ratios from 950 to 15,300. Limited effects of ejector nozzle configuration, diffuser length, system size, and diffuser wall cooling were investigated. Excellent system performance was obtained, with test cell altitudes of 250,000 ft being produced by the pumping action of the ejector at nozzle total pressures of approximately 100 to 200 psia. Author (TAB)

N69-16362# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STUDY OF THE PARAMETERS AND LAWS OF TECHNOLOGICAL PROCESSES WITH THE AID OF SIMULATION DEVICES [IZUCHENIYE PARAMETROV I ZAKONOMERNOSTEY TEKHNOLOGICHESKIKH PROTSESSOV S PRIMENENIYEM MODELIRUYUSHCHIKH USTROYSTV]
Yu. Ye. Yefroymovich 9 Jan. 1968 21 p refs Transl. into ENGLISH from Russian
(AD-678614; FTD-HT-23-642-67) Avail: CFSTI CSCL 13/8

Methods are analyzed for determining the relations which characterize a particular technological process. Knowledge of these relations make it possible to analyze a complicated process in its entirety and to determine the design of optimum process control. The methods described are based on the use of automatic mathematical models. As an example, models of steel smelting and arc furnace processes are worked out. Also analyzed are models of processes which are described by dimensionless nonlinear second and third order differential equations; the method of piecewise linear approximation of a continuous function of the output quantity is used in this analysis. TAB

N69-16367*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland Ohio.
ROLLING-ELEMENT BEARING LIFE FROM 400° TO 600°F
Edwin V. Zaretsky, William J. Anderson, and Eric N. Bamberger (GE, Cincinnati) Washington Jan. 1969 23 p refs
(NASA-TN-D-5002) Avail: CFSTI CSCL 13I

Rolling-element fatigue tests were conducted with 120-mm bore angular-contact ball bearings made of AISI M-50 steel using a synthetic paraffinic oil at temperatures of 400° to 600°F. Bearing life in this temperature range exceeded AFBMA-predicted (catalog) life by a factor greater than 13. Failure was by classical subsurface rolling-element fatigue. Under simulated conditions EHD minimum film thicknesses ranged from 10 to 5 microinches for temperatures from 400° to 600°F, respectively. Author

N69-16377# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE PROCESS OF SHAPING SHELLS WITH CLOSED CONTOURS BY TENSION

A. M. Abramov 30 Nov. 1967 29 p refs Transl. into ENGLISH from Tr. Inst. Aviats. Tekhnol. (Moscow), no. 65, 1966 p 60–85
(AD-678778; FTH-HT-23-1430-67) Avail: CFSTI CSCL 13/13

A complex-problem of production practice was presented by the shaping of large-dimensioned parts of the welded-shell type from heat-resistant and high-strength alloys and ensuring that they are made to high precision. The methods used previously to fabricate these parts were laborious and not productive; they did not deliver the necessary precision and required heavy physical exertion. Such components are now being fabricated with high efficiency by tension shaping with expansion punches on special presses. The present paper presents theoretical and experimental investigations of the process of closed-contour shell shaping by expansion-punch stretching, together with basic recommendations for its use.
Author (TAB)

N69-16388*# United Technology Center, Sunnyvale, Calif.
STUDY OF THE RELIABILITY GROWTH IMPLICATIONS OF SUBSYSTEM VERSUS FULL ASSEMBLY TESTING
W. J. Corcoran and R. R. Read Nov. 1968 46 p refs
(Contract NAS7-356)
(NASA-CR-99139; UTC-2140-FR) Avail: CFSTI CSCL 14D

During a large scale development program, testing takes place at the individual subsystem level as well as at the full assembly level, and each involves separate kinds of engineering problems. The reliability growth and cost implications of various mixes of these two types of testing are studied. The simulation model is used in an empirical approach to the problem, and the leading prediction scheme is used in an analytic approach. The latter is more economical and more flexible, but is restricted to mean value analysis. The ultimate product of the developmental program will be called the system. A system may consist of several components. Each component is expected to operate for a fixed period of time; and because the functioning of a component may be variable during this period, we may decompose it into a contiguous set of nonoverlapping time intervals. The intervals operate sequentially i.e., interval 1 must complete its usefulness before interval 2 begins, etc. Components may operate concurrently and may or may not be identified with a single interval. The reliability of a system is the product of the reliabilities of its components.
Author

N69-16440# Forsvarets Forskningsanstalt, Stockholm (Sweden).
SOME SIMPLE MACHINE ELEMENTS USED IN CONTROL TECHNOLOGY [NAGRA ENKLA MASKINELEMENT I REGLERTEKNISK TILLAEMPNING]
H. Lymark and K. Spets Jul. 1967 33 p refs In SWEDISH
(FOA-2-C-2183-54) Avail: CFSTI

Some fundamental problems and solutions in the construction of small components of electromechanical control systems for military application are discussed. Included are such assemblies as rotating servocomponents, motor couplings, shaft couplings, and data tranamission interfaces as well as screws, nuts, bolts, ball bearings, grooves, and wedges used in control systems. K.W.

N69-16463*# United Aircraft Corp., East Hartford, Conn.
BRAYTON-CYCLE TURBOMACHINERY ROLLING-ELEMENT BEARINGS
R. Cohen, H. Means, and P. Heyl Washington NASA Jan. 1969 288 p refs
(Contract NAS3-7635)
(NASA-CR-1229) Avail: CFSTI CSCL 13I

Evaluated were candidate Brayton-cycle turbomachinery configurations incorporating gas bearings. Pratt and Whitney Aircraft has conducted a development effect on a flight-type rolling element rotor support system to provide a backup to the gas bearing approach. This program included the design of two-shaft Brayton-cycle turbomachinery, the testing of critical rotor support system components and the testing of a pilot lubrication system. As a result of two successful 2500 hour endurance tests, one on a face seal only and the other on a complete pilot lubrication system, it is concluded that a rolling element support system can be developed for missions exceeding one year and the oil contamination level of the Brayton-cycle power system will not exceed one gram.
Author

N69-16524# Forsvarets Forskningsanstalt, Stockholm (Sweden).
MEASURING ANGULAR ERROR AND TORQUE MOMENT CONSTANTS FOR SOME AXIAL COUPLINGS IN PRECISION MACHINERY [MAETNING AV VINKELFEL OCH VRIDFJAEDERKONSTANTER PA NAGRA FINMEKANISKA AXELKOPPLINGAR]
H. Lymark and K. Spets Jul. 1967 19 p refs In SWEDISH
(FOA-2-C-2184-54) Avail: CFSTI

This study demonstrates how the accuracy of angular transmission in small precision machinery systems having mechanical shaft couplings varies with increasing parallel displacement of the shafts. The torque moment constants of the shafts are also determined. The measurements are relevant for couplings in data transducers with the loading shaft in an accurate position of a controlled system.
Author

N69-16665*# Franklin Inst., Philadelphia, Pa. Research Labs.
A FEASIBILITY STUDY: THE APPLICATION OF HYDRODYNAMIC GREASE LUBRICATED SELF-SEALING BEARINGS TO A GYRO SPIN AXIS
J. T. McCabe and F. Kramberger Jan. 1968 77 p refs
(Contract NAS8-20741)
(NASA-CR-98228; I-C2028-1) Avail: CFSTI CSCL 13I

This report is concerned with the application of grease lubricated spiral groove bearings to a gyro spin axis. It contains performance characteristics for the spherical and conical configurations, the analysis used in obtaining these characteristics, an experimental check on the analysis and details on the experimental test facilities that were constructed for feasibility confirmation. Information is also presented on the properties of a lubricant selected from an experimental screening study. Results of the program indicate that a grease lubricated conical bearing with spiral grooves is feasible for certain gyro spin axis applications.
Author

N69-16814# Midwest Research Inst., Kansas City, Mo.
RELATION BETWEEN INORGANIC BINDER WETTABILITY AND SOLID FILM LUBRICANT WEAR-LIFE
William L. Clow Wright-Patterson AFB, Ohio AF Mater. Lab. Nov. 1968 34 p refs
(Contract AF 33(615)-5278)
(AD-678576; AFML-TR-68-313) Avail: CFSTI CSCL 11/8

The conditions necessary for improved wetting of molten B2O3 on molybdenite (MoS2) and M-10 steel were determined. The information gained from the wetting experiments was used to guide the preparation parameters of MoS2:B2O3 solid lubricant films on M-10 substrates. Films were prepared under different conditions designed to produce either good binder wetting or poor binder wetting. Wear-life tests showed superior endurance for the films where binder wetting was good. The conclusion drawn from these experiments is that wear-life of bonded solid films can be related to the binder wetting of film components and substrate.
Author (TAB)

N69-16832# Uniroyal Chemical, Naugatuck, Conn.
MOLDING AND QUALITY ANALYSIS OF ABS SUBSTRATES
John F. Zappale *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 26–34 ref (See N69-16829 06-18)
Avail: Issuing Activity

The advantages of acrylonitrile-butadiene-styrene (ABS) electroplated substrates are discussed, taking into consideration economics, processing conditions, and quality control in screw machine molding. Comparisons are drawn with polypropylene in order to examine the economics and properties of ABS, with emphasis on material and molding costs and plating chemical costs for both substrates. Properties of ABS which are particularly desirable for electroplating processes are its adhesion values, Rockwell hardness, linear mold shrinkage, and impact and flex strength. In addition, ABS is amorphous and, therefore, lacks a sharp freezing point. The various processing conditions required for electroplating with this substrate are outlined. Quality control is assured by the acetic acid test which provides a quick and accurate means for locating stress concentration areas in molded parts. A.C.R.

N69-16833# Shipley Co., Inc., Newton, Mass.
PREPLATE SYSTEMS
Charles R. Shipley, Jr. *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 35-39 (See N69-16829 06-18)
Avail: Issuing Activity

The three major steps required for preplating are described. Preplating processes provide the adhesion of metal to plastics and render the plastics conductive so that electroplating can be performed. The three steps in this process are: (1) conditioning plastic surfaces for adhesion; (2) seeding the plastics with catalytic particles; and (3) performing electroless metal plating to provide conductivity. These steps produce deposits of adherent conductive electroless metal, after which the metal is electroplated to the desired thickness and finish. The differences between electroless copper and electroless nickel as a conductive base for electroplating are also discussed. Aside from decorative plating applications, the choice between copper and nickel depends upon the functional application. A.C.R.

N69-16835# MacDermid, Inc., Waterbury, Conn.
METHODS OF PLATING ON PLASTICS
W. H. Toller *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 44-47 refs (See N69-16829 06-18)
Avail: Issuing Activity

A review of the literature is presented on various methods of increasing the electrical conductivity of plastic surfaces so that the plastic parts can be electroplated in the same manner as metallic parts. Particular emphasis is placed on acrylonitrile-butadiene-styrene (ABS). The methods investigated are: (1) hot metal dipping; (2) metal spraying; (3) metal impregnation; (4) chemical silver processing; (5) conductive lacquer processing; (6) vacuum metallizing; and (7) electroless deposition using nickel or copper. A.C.R.

N69-16836# Borg-Warner Corp., Washington, W. Va. Marbon Div.
PART DESIGN PARAMETERS OF PLASTICS SUBSTRATES FOR PLATING
B. J. Sexton *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 48-56 refs (See N69-16829 06-18)
Avail: Issuing Activity

The fundamentals of plastics design and of applicable electroplating design are discussed in light of the recent increase in production of various types of plated plastic parts, which has resulted in the need to apply current design considerations for maximum performance and economics. The characteristics of plastic parts which must be considered in optimizing design are wall thickness, curvatures, radii and fillets, ribs and bosses, openings, lettering, draft angles and undercuts, and shrinkage. It is found that maximum resistance to extreme temperature changes and to corrosive environment is accomplished by uniform thickness in both plastic substrate and electroplated composite. Gently curved, convex surfaces, radiused angles, and minimum protuberances promote uniform thickness and minimum stress concentration. A.C.R.

N69-16837# Udylite Corp., Detroit, Mich.
METAL PLATING SYSTEMS FOR ABS AND POLYPROPYLENE
Warren R. Doty and Walter Wieczerniak *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 57-61 refs (See N69-16829 06-18)
Avail: Issuing Activity

Due to the growing market for plated plastic parts capable of withstanding exterior exposure, a study was conducted to evaluate the effect of accelerated corrosion on the durability of plated plastics. Polypropylene was used as the substrate in order to minimize the formation of any blisters due to low adhesion or thermal cycling failures. Results are given for combined thermal cycle-CASS testing for five plating systems and compared to steel panels similarly plated. The following combination gave the best performance: 0.8 mil bright acid copper; 0.5 mil semi-bright nickel; 0.3 mil bright nickel; 0.1 mil DurNi(R) nickel; and 0.01 mil chromium. Both acrylonitril butadiene styrene (ABS) and polypropylene parts passed three additional combined thermal cycle-CASS tests for a total exposure of 48 hours using this combination. A.C.R.

N69-16840# Sterling Faucet Co., Morgantown, W. Va.
THE FUTURE OF PLATED PLASTICS IN PLUMBING
L. K. Jones *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 68-70 (See N69-16829 06-18)
Avail: Issuing Activity

The early use of electroplated plastic parts in the plumbing industry is discussed, and future applications of plated plastics in this industry are suggested. A.C.R.

N69-16841# General Motors Research Labs., Warren, Mich.
PLATING ON PLASTICS—A PRAGMATIC LOOK AT THE PROBLEMS
Seward E. Beacom *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 71-83 refs (See N69-16829 06-18)
Avail: Issuing Activity

In spite of progress being made in the plating of plastics for automotive applications, a number of critical problems still remain unsolved. Some methods are suggested for extracting the maximum amount of information from the test programs being carried out by both suppliers and users. Specific items include adhesion testing, thermal cycle testing, and corrosion testing, and the need for the development of new, platable plastics. Author

N69-16861*# Mechanical Technology, Inc., Latham, N. Y.
ANALYSIS, DESIGN, AND PROTOTYPE DEVELOPMENT OF SQUEEZE-FILM BEARING FOR AB-5 GYRO. Final Report Phase 2, DESIGN, FABRICATION AND EVALUATION OF PROTOTYPES
C. H. T. Pan, F. K. Orcutt, and B. R. Teitelbaum 31 May 1967 86 p refs
(Contract NAS8-11678)
(NASA-CR-98230; MTI-67TR17) Avail: CFSTI CSCL 13I

Experimental studies on two cylindrical journal and annular bearing prototypes and the design and fabrication of the prototypes are described. The tests and difficulties encountered with the first prototype are reviewed and the resulting design improvements are indicated. With the second prototype, measurements were made of free crystal vibration, and also with the instrumented and uninstrumented floats. The results obtained from radial and axial loading are discussed. Details are presented on the design and fabrication of the two experimental squeeze-film bearing transducers and electrical drives. The transducer design incorporates a

lead-zirconate-titanate piezoceramic cylinder with a relatively thick wall, plated end electrode configuration, nickel plating, and heat-treat stabilizations. The cylinder characteristics were determined to be generally as favorable as those of the phase one cylinder.
N.E.N.

N69-16955* Parker Aircraft Co., Los Angeles, Calif. Systems and Advanced Components Div.
PROGRAM SUMMARY REPORT 10-INCH LOX VENT AND RELIEF VALVE, PN 5640073
M. C. Trautner 31 Mar. 1967 26 p refs
(Contract NAS8-11633)
(NASA-CR-98226; EDR-5640073) Avail: CFSTI CSCL 13K

This report summarizes the efforts on the 10-inch LOX program. The program included complete design, development and manufacturing effort required to supply valves in two configurations (25 psig flight, and 52 psig test) and a mating coaxial tank sensing line. The valve was designed to open, as required, to limit the pressure in the LOX tank in the event of tank pressurization control failure. Two modes of actuation are provided to accomplish this function. The primary mode consists of an external 750 psig command signal controlled by a pressure switch and applied to the override actuators. In the event this command is not received, the valve senses tank pressure through an auxiliary tank pressure sensing line and automatically opens using tank pressure as the power fluid. In this mode of operation the valve modulates flow to control tank pressure to a preset level. The second function of the valve is to open the tank during LOX loading. This is accomplished by applying a ground controlled pressure to the override actuators.
Author

N69-17104*# Utah Univ., Salt Lake City. Mechanical Engineering Dept.
FREE RADICAL FORMATION DURING MACHINING AND FRACTURE OF POLYMERS
D. K. Backman and K. L. De Vries Dec. 1968 19 p refs
(Grant NGR-45-003-037)
(NASA-CR-73717; UTEC-ME-68-099) Avail: CFSTI CSCL 13H

Electron paramagnetic resonance measurements of the number of free radicals formed during cutting and grinding of polymers are described. It was found in the semi-crystalline polymers studied that below the glassy transition temperature about 2×10^{13} free radicals are formed per sq cm of surface formed. It is proposed that this number results from the crack progressing selectively through the glassy regions about more ordered regions in the polymers.
Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N69-16216# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
MAGNETIC RESONANCE STUDIES AND PHYSICAL PROCESSES IN MASERS Final Report, 1 Aug. 1966-31 Mar. 1968
N. Bloembergen Sep. 1968 21 p refs
(Contract Nonr-1866(28))
(AD-678729; TR-570) Avail: CFSTI CSCL 20/5

The report summarizes research performed under the contract in the following areas: Magnetic relaxation studies and physical processes in masers; Pressure and electric field effects in magnetic resonance; Nonlinear optics.
TAB

N69-16355# Rensselaer Polytechnic Inst., Troy, N. Y. Div. of Electrophysics.
ELECTRON RADIATION TEMPERATURES AND OPTICAL GAIN MEASUREMENTS IN A CO_2 LASER AMPLIFIER Annual Report
J. H. Noon, E. H. Holt, P. R. Blaszuk, and R. G. Buser Ft. Monmouth, N. J. Army Electron. Command Oct. 1968 16 p refs
(Contract DAAB07-67-C-0533)
(AD-678487; ECOM-3037) Avail: CFSTI CSCL 20/5

Combined optical gain at 10.6 mu M and electron radiation temperature measurements at an X-band microwave frequency have been carried out on a small bore CO2 laser amplifier. Measurements were made over an extended pressure range in a flowing gas system, studying the transition from gain to loss as well as conditions for maximum gain both for pure CO2 and with N2 and He as additives. No significant variation of the radiation temperature was observed, which shows that the addition of He does not cause a change in the average electron energy. Increased gain must therefore be attributed to the He directly affecting the excited CO2 laser levels.
Author (TAB)

N69-16631# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A QUASICONTINUOUS LASER WITH PYROTECHNIC EXCITATION
A. I. Bodretsova et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 150-154 refs (See N69-16610 06-34)
Avail: CFSTI

Preliminary experimental studies were made to produce an economical laser pumped by a pyrochemical source. The $CaWO_4:Nd^{3+}$ (neodymium concentration was 1 wt% of Nd_2O_3) single crystals were prepared by the Czochralski process, and their spectroscopic data are given. The pump system consisted of a cylindrical reflector (80 mm long) with an elliptic cross section (eccentricity 0.42). At one of its foci is a cylindrical crystal rod 42 mm long and 3 mm in diameter with polished sides. The rod ends are spherical and covered with multilayer dielectric mirrors for 1% transmission at 1.06 μ. The mirror radius of curvature is 42 mm. At the other focus is a pyrochemical pump consisting of a quartz tube 20 mm in diameter and 120 mm long. Inside the tube there is a crossarm-affixed plate of a two component compressed mixture of pyrochemical material (fuel and oxidizer). The mixture is ignited by a supporting thin tungsten wire fed by a 6v dc or ac supply. The oxidizer is $KClO_4$ and the fuel is Zr.
Author

N69-16632# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE FINE STRUCTURE OF THE SPECTRA OF GALLIUM ANTIMONIDE LASER DIODES
I. V. Kryukova et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 158-161 refs (See N69-16610 06-34)
Avail: CFSTI

The fine structure of coherent emission from GaSb p-n junctions produced by drawing the crystal by the Czochralski method is investigated. The Fabry-Perot resonator was produced by optical polishing. The pulsed laser output consisted of pulses of 1 μsec duration with the repetition frequency of 40 Hz. The measurements were made at liquid nitrogen temperature. The results show that at the generation threshold it is possible to obtain a single narrow line at the stimulated emission maximum.
Author

N69-16633# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ISOTOPIC SHIFT OF GENERATION FREQUENCY IN GAS LASERS

Ye. A. Vernyy et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 162–163 ref (See N69-16610 06-34)
Avail: CFSTI

A simple method of obtaining a 1GHz frequency shift in a gas laser is suggested. This is accomplished by using isotopes of elements at which lasing action is observed (Ne^{20} and Ne^{22} for the Ne I line, Ar^{36} and Ar^{40} for the Ar II line, or O^{16} and O^{18} for the O I line). Experiments were carried out with hellium–neon lazer operating at the 6328 Å line with ≈1 m long cavities and 120 to 150 cm spacing between mirrors. One contained natural neon, and the other Ne^{22} enriched to 91%. Narrow generation lines were obtained by operating near threshold at low pump energy. The radiation from the two lasers was combined with a semitransparent plate and fed to a Fabry–Perot interferometer, behind which an f = 130 cm camera was located. The shift was determined from the interference pattern by the rectangular table method. The measured value $(22.8 \pm 2) \times 10^{3}$ cm^{-1}, agrees within the limits of error with the theoretical expectation. Author

N69-16634# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESONATOR QUALITY MODULATION FOR A NEODYMIUM-DOPED GLASS LASER BY MEANS OF POLYMETHYNE DYES
O. L. Lebedev et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 164–166 refs (See N69-16610 06-34)
Avail: CFSTI

The influence of the nature of the polymethyne dyes and solvents on the energy of a giant laser pulse is studied. The dyes investigated were tricarbocyanine (xenocyanine), tetracarbocyanine, thiapentacarbocyanine, and dibenzothiapentacarbocyanine. The maximum laser output energy was found to increase with decreasing transparency of the dye, and no energy saturation was attained with the given laser setup. In spite of the differences in the absorption spectra, the energy yield of the laser was approximately the same for the pentacarbocyanines. When propanol was used as the solvent, the energy yield of the laser decreased. The energy also decreased when tricarbocyanine was used. It was noted that tricarbocyanine can be bleached, in spite of its low absorption coefficient at the neodymium line. The experiments were made with a rod 10 mm in diameter and 120 mm long. The optical cavity was made up of a dielectric mirror and a glass stack. The energy was measured with a calorimeter. Author

N69-16792# Rensselaer Polytechnic Inst., Troy, N. Y. Electrophysics Div.
ARGON ION LASER UTILIZING A HOLLOW CATHODE GAS-FED ARC
J. H. Noon, E. H. Holt, W. C. Jennings, and R. G. Buser (Army Electron. Command) Ft. Monmouth, N. J. Army Electron. Command Oct. 1968 29 p refs
(Contract DAAB07-67-C-0533)
(AD-679144; ECOM-3032) Avail: CFSTI CSCL 20/5

Details are given of the construction and operating characteristics of a new type of argon ion laser based on the hollow cathode gas fed arc as an energy source. This device represents a significant improvement over conventional argon ion lasers. It is easy to replace components, and erosion and gas cleanup problems are minimized. Threshold conditions for the 4765, 4880, 4965 and 5145 angstrom lasing lines are given and the effect of electrode geometry, discharge current, pressure and magnetic field are considered. The use of annular discs to confine the arc column is also discussed. Author (TAB)

N69-16802# Army Electronics Labs., Fort Monmouth, N. J.
LONG-LIFE HIGH-REPETITION-RATE FLASH TUBES
Norman L. Yeamans and John E. Creedon Nov. 1968 12 p refs
(AD-679146; ECOM-3043) Avail: CFSTI CSCL 20/5

The standard flash tube is designed for single-shot applications and has a life rating based on the energy per pulse. Recent optical pumps for laser applications require operation of flash tubes at high repetition rates. A new approach to achieving long life has been investigated utilizing different constructional techniques and new modes of operation. Author (TAB)

N69-16805# Westinghouse Research Labs., Pittsburgh, Pa.
OPTICAL PUMPS FOR LASERS—PHASE 2 Final Report, 1 Apr. 1966–30 Jun. 1968
I. Liberman, D. A. Larson, R. G. Young, L. Armstrong, Jr., R. Liebermann et al Ft. Monmouth, N. J. ECOM Oct. 1968 334 p refs
(Contract DA-28-043-AMC-02097(E))
(AD-679143; ECOM-02097-F) Avail: CFSTI CSCL 20/5

The work covered in this report is separated into three tasks. Task I describes the way high efficiency continuous pumping of Nd:YAG has been achieved through the use of spectral additive lamps. Task II describes the development of a long life xenon flash lamp suitable for pumping Nd:YAG at high repetition rates. Task III describes the development of theoretical techniques for determining the spectra from lamps so that in conjunction with a known absorption spectrum from a laser material, the most efficient pump can be predicted. Author (TAB)

N69-16971*# Philco-Ford Corp., Newport Beach, Calif. Aeronutronic Div.
INVESTIGATION OF DUAL POLARIZATION LASER MODULATION
W. M. Doyle, W. D. Gerber, and M. B. White 25 Oct. 1968 92 p refs
(Contract NAS9-7420)
(NASA-CR-92484; U-4559) Avail: CFSTI CSCL 20E

This research program is aimed at determining the applicability of the dual polarization on laser to side band optical communication. A major part of this program has been devoted to a study of the bandwidth capabilities of a frequency modulated dual-polarization laser. Experiments were carried out with 1.15μ and 3.39μ He–Ne lasers, modulation frequencies of up to 20 MHz, and fm bandwidths of up to 130 MHz. The results indicate that the achievable bandwidths are considerably greater than would be anticipated on the basis of the static laser characteristics and that the limitations which do occur are of a type which would have a minimal effect on the operation of an fm communication system. Additional He–Ne experiments demonstrated the active frequency stabilization of the modulated DP laser and determined the effect of modulation on the stabilization characteristics. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N69-16163# Naval Research Lab., Washington, D. C.
KISCC STRESS-CORROSION TESTS OF HY-140 WELDS FOR DSRV-2 Memorandum Report
Hugh E. Romine and Herschel L. Smith Sep. 1968 31 p refs
(AD-679230; NRL-MR-1923) Avail: CFSTI CSCL 11/6

Stress corrosion fracture toughness measurements were made on the welds of 2 in. thick HY-140 material intended for use in the DSRV-2. The welds were of the standard TIG type using the same joining practice as that for the pressure spheres. At this level of fracture toughness critical flaw sizes are of sufficient size that they should be easily detected during non-destructive inspection. Author (TAB)

N69-16224 Case Western Reserve Univ., Cleveland, Ohio.
SUBSTRUCTURE AND MECHANICAL BEHAVIOR OF TUNGSTEN AS FUNCTION OF PRESSURE
Gobinda Das (Ph.D. Thesis) 1967 176 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-10151

The effects of the application of hydrostatic pressure on the dislocation substructure and mechanical behavior observed at atmospheric pressure were investigated for polycrystalline tungsten. Tensile tests were conducted from 25 to 250°C at atmospheric pressure on specimens subjected previously to pressures up to 25 kilobars and at room temperature during subjecting to pressures up to 11 kilobars. The substructures and fractured surfaces were examined by optical, transmission electron microscopy and electron fractography. The ductile–brittle transition behavior of recrystallized tungsten and a tungsten 1.9 vol. % thoria alloy are essentially unaffected by pressure cycling up to 25 kilobars at atmospheric temperature. Only in tungsten containing added second phase particles of ThO_2 and HfC were new dislocations observed, and then only for pressures above 25 kb. Dissert. Abstr.

N69-16225 Florida Univ., Gainesville.
SOME ANELASTIC PROPERTIES OF ZIRCONIUM RESULTING FROM PRESTRAIN AT 77°K
Edward Philip Dahlberg (Ph.D. Thesis) 1967 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-9466

The mechanical hysteresis and anelastic properties of polycrystalline zirconium are studied which result from the reversible thermally activated motion of the boundaries of deformation twins. Straight rolled polycrystalline zirconium plate stock was prestrained at 77°K in order to nucleate numerous fine $\{11\bar{2}1\}$ twins in an otherwise almost undistorted matrix. Subsequent tensile deformation at elevated temperatures showed marked deviation from linear behavior in the stress-strain curves at an initial resolved shear stress of approximately 2,500 psi, which is at least ten times lower than the normal 0.2 per cent offset yield point for this material. The development of large anelastic strain at comparatively low stress levels indicates the ease with which $\{11\bar{2}1\}$ twin boundaries are able to move. On cyclic loading at low frequencies in a tensile machine, large mechanical hysteresis energy losses were observed over the range of temperature from −72° C to 80° C. Comparative area measurements of the hysteresis loops showed the energy losses were a sensitive function of the amount of prestrain and reached a maximum at approximately 0.65 per cent prestrain. Dissert. Abstr.

N69-16244# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT TREATMENT OF NEW CAST ALUMINUM ALLOYS
N. N. Belousov et al 25 Jan. 1968 37 p refs Transl. into ENGLISH from a Russian paper
(AD-678793; FTD-MT-24-337-67) Avail: CFSTI CSCL 11/6

Contents: Brief outline of new thermally hardenable aluminum alloys included in GOST 2685-63; Heat treatment of alloys of the system Al-Mg; Heat treatment of new complex alloys based on the Al-Cu system; Heat treatment of alloys of the Al-Zn-Mg system; Typical of heat treatment methods of new cast aluminum alloys; and Air assemblies for heat treatment of aluminum alloys. TAB

N69-16260# Naval Research Lab., Washington, D. C. Strength of Metals Branch.
FATIGUE CRACK GROWTH IN THREE 180-KSI YIELD STRENGTH STEELS IN AIR AND IN SALT-WATER ENVIRONMENTS Interim Report
T. W. Crooker and E. A. Lange 26 Sep. 1968 18 p refs
(AD-678726; NRL-6761) Avail: CFSTI CSCL 11/6

Fatigue crack propagation studies were conducted on three high-strength structural steels: 9Ni-4Co-0.25C, 12Ni maraging, and 18Ni maraging. Each of the steels was heat treated to a yield strength of 180 ksi. Tests were performed in two environments, a dry environment consisting of ambient room air and a wet environment consisting of 2.5-percent-NaCl salt water. Relationships for fatigue crack growth rates as a function of the fracture mechanics stress-intensity factor (K) are developed for each steel, in both environments. The engineering significance of these relationships are then presented in terms of stress levels and flaw sizes relevant to the steels under investigation. Author (TAB)

N69-16263# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF ALLOYS OF THE Nb-Zn SYSTEM
A. I. Yevstyukhin et al 4 Jan. 1968 14 p refs Transl. into ENGLISH from Inzh.-Fiz. Inst., Met. i Metalloved Chistykh Metallov (Moscow), no. 5, 1966 p 51–59
(AD-678769; FTD-HT-23-1204-67) Avail: CFSTI CSCL 11/6

A series of binary niobium-zinc alloys containing 4.9-52.7% niobium were melted from 99.8%-pure niobium and chemically pure zinc in argon-filled airtight crucibles held at 1150C for 20 hr. Alloys containing up to 20% niobium were dense; those with a higher niobium content were porous. Author (TAB)

N69-16278# Oak Ridge National Lab., Tenn.
SOL-GEL THORIA EXTRUSION
R. B. Fitts, H. G. Moore, A. R. Olsen, and J. D. Sease Sep. 1968 31 p refs
(Contract W-7405-ENG-26)
(ORNL-4311) Avail: CFSTI

The sol-gel process provides a stable colloidal suspension of various ceramic materials. This suspension, or sol, may be concentrated, dried, and fired at low temperatures to form dense ceramic bodies. Standard ceramic equipment and the concentrated sol, or clay, with powder additions to extrude pure oxide ceramic bodies of various shapes and controlled density are used. The extrusion blend requires no extraneous binders or plasticizers. It was demonstrated in laboratory-scale work that this process produces high-strength solid and cored extrusions of thoria free at 1150°C with controlled densities ranging from 70 to 99% of theoretical and with diameters up to 1/2 in. (±0.001 in.) and lengths to 3 in. The effects of various powder additions and drying conditions on extrusion quality and density are defined. This process, proven in the thoria system, may make improvement and greater economy possible in the fabrication technology for ceramic shapes of zirconia, alumina, and other ceramics amenable to the sol-gel process. Author (NSA)

N69-16358# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE USE OF FAST ELECTRONS IN METALLOGRAPHIC INVESTIGATIONS
I. M. Pronman 28 Mar. 1968 11 p refs Transl. into ENGLISH from Russian Presented at the Mezhvuz. Konf. po Elektronnoi Uskoritele, Tomsk, USSR, 17–21 Mar. 1964 Submitted for publication
(AD-679386; FTD-HT-23-133-68) Avail: CFSTI CSCL 11/6

Ionization and mixing of atoms during electron bombardment may affect phase transformations in alloys containing phases with

intermediate properties, ionic bonds, or metastable bonds. It is shown that the joint radiative-thermal effect, including the heating during irradiation, leads to a phase transformation in white iron. The disintegrating cementite is replaced by ferrite with spheroidal graphite. It is assumed that, in the processes being studied the function of the nonlocal warmup under an electron beam is the same as that of local bursts of heat during neutron irradiation, and that this function is reduced to acceleration of the diffusion processes. TAB

N69-16358# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF DEFORMABILITY R18 STEEL AT HIGH LOAD VELOCITIES

P. A. Meschanchuk et al 9 Jan. 1968 113 p refs Transl. into ENGLISH from Kuznechno-Shtampovochnoye Proizv. (USSR), no. 2, 1967 p 14–18

(AD-678780; FTD-HT-23-1460-67) Avail: CFSTI CSCL 11/6

The authors describe experimental studies conducted to determine the deformability of a high-speed tool steel under conditions of rapid loading. Ductility and resistance to deformation were determined during upsetting of cylindrical specimens between flat striking blocks. The results of these tests indicate that high rates of deformation are not detrimental to the quality of the tool steel. Author (TAB)

N69-16380*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HIGH TEMPERATURE MECHANICAL PROPERTIES OF POLYCRYSTALLINE HAFNIUM CARBIDE AND HAFNIUM CARBIDE CONTAINING 13-VOLUME-PERCENT HAFNIUM DIBORIDE

William A. Sanders and Hubert B. Probst Washington Jan. 1969 23 p refs

(NASA-TN-D-5008) Avail: CFSTI CSCL 11F

Hot pressed, single phase HfC and HfC containing 13-vol % HfB_2 were tested in three point transverse rupture to temperatures as high as 4755°F. Hot hardness tests were also run to 3200°F. Separate effects on the transverse rupture behavior of HfC due to the HfB_2 second phase and due to a grain size difference are discussed on the basis of strength, deformation, and metallographic results. The probable mechanisms responsible for deformation are also discussed. In hot hardness tests of HfC containing 13 vol % HfB_2 second phase, a change in the temperature dependency of hot hardness at 2600°F is discussed and related to the degree of cracking around indentations. Author

N69-16383*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYTICAL STUDY OF FLOW REDUCTION DUE TO OXIDATION OF WIRE-FORM POROUS SHEET FOR TRANSPIRATION COOLED TURBINE BLADES

Albert Kaufman Washington Jan. 1969 23 p refs

(NASA-TN-D-5001) Avail: CFSTI CSCL 11F

Cyclic and static oxidation data for wires of N155, Driver-Harris 242, TD nickel-chromium, and Hastelloy X from 1400°F to 2000°F were used to determine flow reduction effects for pore diameters from 10 to 100 micrometers and exposure times up to 600 hours. Analytical results were compared with experimental flow reduction data for oxidized wire-form porous sheets from other investigators. Conclusions were drawn as to the suitability of these materials for transpiration cooling with a metal temperature of 1800°F. Author

N69-16465*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HOT-SALT STRESS-CORROSION OF TITANIUM ALLOYS: GENERATION OF HYDROGEN AND ITS EMBRITTLING EFFECT

Hugh R. Gary Washington Jan. 1969 20 p refs

(NASA-TN-D-5000) Avail: CFSTI CSCL 11F

Alloy specimens of Ti-8Al-1Mo-1V were salt coated and exposed to conditions conducive to hot salt stress corrosion. Subsequent tensile tests revealed that ductility was strain-rate and temperature sensitive. Embrittlement was more pronounced at slow crosshead speeds in the vicinity of ambient temperature. After salt exposure, ductility was restored by vacuum annealing. Substantial increases in hydrogen content were measured in embrittled specimens. These results demonstrate that hydrogen can be generated during elevated temperature exposure to salt and that the subsequent embrittlement is a manifestation of the phenomenon of slow-strain-rate hydrogen embrittlement. Author

N69-16511 National Lending Library for Science and Technology, Boston Spa (England).

TRIPLE CHALCOGENIDES OF GALLIUM

L. S. Palatnik and E. K. Belova 23 Oct. 1968 13 p refs Transl. into ENGLISH from Neorganischeskie Materialy (USSR), v. 3, no. 6, 1967 p 967–973

(NLL-RRE-Trans-208-(8036.625) Avail: Natl. Lending Library, Boston Spa, Engl.

The phase diagrams and structure of alloys in $A_2^{I}C^{VI}$–$B_2^{III}C_3^{VI}$ systems (where A^{I} is Cu, Ag; B^{III} is Ga; C^{VI} is Se, Te) were investigated over the 40 to 60 mol. % $B_2^{III}C_3^{VI}$ concentration range. The compound $AgGaSe_2$, which melts congruently, is the most stable of the chalcogenides which were investigated. Selenide $CuGaSe_2$ and telluride $AgGaTe_2$ decompose by peritectic reaction when heated, and alloys, corresponding to the CuGaTe composition, decompose by synthetic reaction in the 845 to 880° C temperature range. A δ-phase of variable composition on the basis of triple chalcogenides of the $A^{I}B^{III}C^{VI}_2$ type with a chalcopyrite-type lattice exists in all the systems investigated. In the systems with tellurium the region of homogeneity of these phases does not include the stoichiometric composition $A^{I}B^{III}C^{VI}_2$, but in systems with selenium it is included. δ-phases in the Ag_2Se–Ga_2Se_3, Cu_2Se–Ga_2Se_3 and Ag_2Te–Ga_2Te_3 systems are ordered right up to the temperature of melting or decomposition. In the Cu_2Te–$GaTe_3$ system, the δ-phase transforms to a disordered condition when heated. Author

N69-16607# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHASE TRANSFORMATIONS IN METALS AND ALLOYS (SELECTED ARTICLES)

7 Dec. 1967 19 p refs Transl. into ENGLISH from Fazovye Prevrashch. Metal. Splavakh. Akad. Nauk Ukr. SSR (Kiev), 1965 p 100–110, 127–131

(AD-678781; FTD-HT-23-1472-67) Avail: CFSTI CSCL 11/6

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N69-16808# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILIZATION OF REVERSE MARTENSITE TRANSFORMATION UNDER THE INFLUENCE OF INTRAPHASE WORK HARDENING

V. G. Gorbach *In its* Phase Transformations in Metals and Alloys 7 Dec. 1967 p 1–10 refs (See N69-16607 08-17)
Avail: CFSTI

Specimens from Fe–Ni, Fe–Ni–Cr, and Fe–Ni–Cr–Si were homogenized and forged, then cooled in liquid N, and annealed at 1100°. Subsequently the specimens were cooled again in liquid N (in order to produce martensite). Some of these specimens were heated to 580° to 700° (in order to produce α–γ transformation), and again cooled in liquid N. In this way two kinds of martensits were produced: α_1 produced from annealed austenite and α_2 produced from austenite which was internally work hardened. The latter martensite had a different structure from that produced from annealed austenite. The blocks showed considerable disorientation; the martensitic plates were smaller than initially, were very fragmentized, and showed a great number of internal boundaries. Work hardening inhibited reverse martensitic transformation and stabilized it. The concentration of C had little effect on the stabilization of martensite. The causes of the stabilization are seen in structural changes rather than in redistribution of C and N.
Author

N69-16609# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRUCTURAL CHANGES DURING DECOMPOSITION OF SUPERSATURATED SOLID SOLUTION OF TUNGSTEN IN COBALT

L. N. Larikov et al *In its* Phase Transformations in Metal and Alloys 7 Dec. 1967 p 11–14 refs (See N69-16607 08-17)
Avail: CFSTI

Structural changes were studied during the last stages of the aging of Co–W alloys containing 31.89% W, i.e., close to the solubility of W (32%) at the peritectic temperature (1100°). The alloy was prepared in an Ar atmosphere in a high-frequency furnace, and specimens were homogenized for 15 hr in vacuum at $\geq$ 1100° and then squenched in water. Microstructural, X-ray, and dilatometric studies were carried out, and microhardness, Young modulus and damping decrement were determined. The mechanism of supersaturated solid solution of W in Co was heterogenous even at early stages of aging (after 30 min at 700°). The kinetic curve had the usual (for this type of transformation) sigmoid shape. The alloy had a face-centered lattice with a parameter 3.873 Å. The damping curve showed a maximum at holding periods 7.5 to 9 hr, which is explained by the fact that the amount of residual W dissolved in solid solution is close to the saturation limit at the given temperature.
Author

N69-16761# Little (Arthur D.), Inc., Cambridge, Mass.

MECHANISMS OF OXIDATION OF Ta-10W ALLOY COATED WITH WSi_2 Final Report

Joan B. Berkowitz Watertown, Mass. Army Mater. and Mech. Res. Center Apr. 1968 40 p refs
(Contract DAAG46-67-C-0135(X))
(AD-678610; AMMRC-CR-68-08(F)) Avail: CFSTI CSCL 11/2

Continuous oxygen consumption measurements have been made on two commercially available tungsten/silicon type coatings at temperatures between 1000 and 1800C and an oxygen partial pressure of 150 torr in helium. The coatings were applied to small cylindrical pellets of Ta-10W. The coated samples undergo significant changes in properties if pre-heated in non-oxidizing atmospheres.
Author (TAB)

N69-16843*# Tyco Labs., Inc., Waltham, Mass.

LEAD TELLURIDE BONDING AND SEGMENTATION STUDY Semiannual Phase Report, 1 Feb.–31 Jul. 1968

H. Bates, F. Wald, and M. Weinstein 31 Jul. 1968 65 p refs
(Contract NAS5-9149)
(NASA-CR-73658; SAR-2) Avail: CFSTI CSCL 11F

Constitutional results are presented on the Co–Si–Ge system and the PbTe–MnTe system. In substantial detail, life testing of elements and couples is discussed, and data for couples tested over 2900 hours under gradient conditions are shown.
Author

N69-16866 National Lending Library for Science and Technology, Boston Spa (England).

ZONE MELTING: THE PREPARATION OF HIGH PURITY NICKEL

G. Dressler 24 Oct. 1968 4 p Transl. into ENGLISH from Ber. Intern. Symp. (Germany), 1965, 1966 p 476–477
(NLL-Trans-68/253-(9022.4) Avail: Natl. Lending Library, Boston Spa, Engl.

Sintering of carbonyl nickel powder in a wet hydrogen atmosphere reduces the carbon and sulphur content. The other impurities (Fe, Si, Mg, C, Cu, N, O, H) are removed by the zone refining technique. The "floating zone" method is most effective in reducing the impurity level when applied in a high vacuum. Rate and direction as well as the process of the purification progress in terms of bar length and number of passes. The impurities are mainly removed by evaporation. The impurity content of the resulting high purity nickel was 10–20 wt.ppm. The corresponding recrystallization temperature was 220° C, and the residual resistance ratio was $R_{4.2}/R_{273} + 3.6 \times 10^{-4}$.
Author

N69-16890*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

INVESTIGATION OF THE REINFORCEMENT OF DUCTILE METALS WITH STRONG, HIGH MODULUS, DISCONTINUOUS, BRITTLE FIBERS Final Report 1 Nov. 1967–31 Oct. 1968

A. Gatti, J. M. Barry, J. V. Mullin, J. J. Gebhardt, and E. Feingold Dec. 1968 125 p refs
(Contract NASw-1543)
(NASA-CR-73739; FR-2410-2E2) Avail: CFSTI CSCL 11D

This program was undertaken to define and investigate the critical factors affecting the reinforcement of ductile metals with short, brittle fibers. The materials selected for study were aluminum (or its alloys) and ductile epoxies reinforced with B_4C whiskers or with high modulus filaments, such as B_4C/B/W, SiC/W, B/W, etc. Related tasks in the program included the development of a more economical process for growing B_4C whiskers, the investigation of deposition parameters, the production of continuous B_4C filaments, and the characterization of the individual constituents in the final composites. The latter task involved a study of the structural and chemical interactions of the combined elements (fibers, matrix, coatings, etc.).
Author

N69-16895 National Lending Library for Science and Technology, Boston Spa (England).

WEAR AND FATIQUE OF STEEL UNDER MULTIPLE IMPACT LOADS UNDER THE CONDITIONS OF A FLUID ABRASIVE MEDIUM

S. S. Ermakov Sep. 1968 7 p In ENGLISH and RUSSIAN Transl. into ENGLISH from Mat. i Term Obrabotka. Mater. Konf., Odessa, 1962 p 263–271
(NLL-Trans-68/263-(9022.4)) Avail: Natl. Lending Library, Boston Spa, Engl.

A technique is examined for testing steel under repeated impact loads in a fluid abrasive medium. This method was developed because test and service results with steel parts revealed discrepancies which were attributed to the fact that many test properties are determined under static load or in tests involving rupture under a single impact. Such tests do not always correspond to real service conditions. A detailed description is given of the installation developed for the experiment, and test data on the impact fatigue and abrasive wear of steel are analyzed. A.C.R.

N69-16946# Brown Univ., Providence, R. I. Div. of Engineering.
FIELD ION MICROSCOPY OF CARBIDES OF TUNGSTEN FORMED EXTERNALLY AND IN SITU
M. H. Richman and W. D. Sproul Oct. 1968 21 p refs Sponsored in part by Am. Iron and Steel Inst.
(Contract ARPA SD-86)
(AD-678755; ARPA-E61; AISI-20012) Avail: CFSTI CSCL 11/6

The field ion images of carbides of tungsten produced by in-situ and external carburization processes are compared for the compounds W2C and WC. In both cases it is found that the ion images are identical and that they correspond to the crystal structure normally associated with the bulk forms of these two compounds. Author (TAB)

N69-16984 National Lending Library for Science and Technology, Boston Spa (England).
YOUNG'S MODULUS AND THE DELTA E EFFECT IN INVAR-TYPE Fe–Ni–Ti Alloys
A. M. Tseitlin and V. Y. Zubov 29 Jul. 1968 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), v. 11, no. 2, 1968 p 110–114
(NLL-Trans-68/151-(9022.4) Avail: Natl. Lending Library, Boston Spa, Engl.

This study investigates the influence of various degrees of deformation, effected by drawing, on the Young's modulus and its temperature dependence for alloys of iron (0.03% C, 0.4% Mn, 0.3% Si, 0.05% Al, 0.2% Cr, 0.2% Co, 0.02% P) with nickel (30–47%) and titanium (2.2%). Such alloys form a base of the widely-used precipitation hardening Elinvars, whose thermo-elastic coefficient is close to zero and can be regulated. Hotrolled rods were homogenized and drawn into wire of 5-mm diameter. After deformation, with or without recrystallization at 1100°C, the specimens were employed for determining Young's modulus E at room and elevated temperatures, texture and microstructure. Experimental results indicated that: (1) the increase of Young's modulus with increasing degree of reduction is more pronounced after subsequent recrystallization; (2) the effect of plastic deformation on Young's modulus depends on the nickel content of the alloy. A.L.

N69-16998 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS INTO UTILIZATION OF ULTRASONIC ATTENUATION MEASUREMENTS FOR DISTINCTION OF VARIOUS MICROSTRUCTURES OF STEEL 42 Cr Mo 4
J. Pirs 18 Oct. 1968 25 p refs Transl. into ENGLISH from Materialprufung (Duesseldorf), v. 10, no. 2, Feb. 1968 p 43–49 In ENGLISH and GERMAN
(NLL-EE-Trans-1815-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.

Quantitative attenuation measurements of ultrasonic energy were made on three charges of chromium–molybdenum steel using laminar specimens of different structures. The specimens were characterized by ferritic-pearlitic structure, intermediate structure, and martensitic structure. The highest values of the sound attenuation are found in the ferritic-pearlitic structure; the medium and lowest values appear in the intermediate structure and martensite, respectively. The differences between pearlite and intermediate structure, and between intermediate structure and martensite, are mainly a consequence of the Rayleigh scattering in these structures. Author

N69-17021# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
DIFFUSION OF CADMIUM IN LEAD
J. Wesley Miller Oct. 1968 32 p refs
(Contract N00014-67-A-0298)
(AD-679205; TR-18) Avail: CFSTI CSCL 11/6

The diffusivity of cadmium in high purity lead single crystals has been measured from 150C to the melting point using tracer and sectioning techniques. Lead self-diffusivity is enhanced by the addition of cadmium. Comparing the diffusion data for several impurities in lead, it is pointed out that the dominant mechanism of solute diffusion, and hence the diffusion rate as well, is determined primarily by the solute valence. It is then considered that the dominant diffusion mechanism of a particular solute is a natural consequence of its degree of interstitial dissolution, and that solute valence plays a major role in determining the energetics of interstitial dissolution. Author (TAB)

N69-17106# Gulf General Atomic, San Diego, Calif.
PROPERTIES OF SILICON CARBIDE RELEVANT TO ITS PERFORMANCE AS A COATING FOR HIGH TEMPERATURE NUCLEAR FUEL PARTICLES
R. J. Price, T. D. Gulden, and J. L. Kaae 1 Mar. 1968 21 p refs
(Contract AT(04-3)-633)
(GAMD-8415) Avail: CFSTI

The physical properties of SiC are described. Results are presented from a mathematical model analysis of the stress state in a composite coating of PyC–SiC on a fuel particle as a function of burnup and neutron radiation. NSA

N69-17115# European Atomic Energy Community, Brussels (Belgium).
STAINLESS STEEL CLADDING OF HEAVY GAGE STEELS Quarterly Report, 1 Jan.–31 May 1968
31 May 1968 26 p Transl. into ENGLISH from Soudometal rept.
(Contract EURATOM-008-63-12-TEEB (ED))
(EURAEC-2050; EUR-3993; QR-15) Avail: CFSTI

The 15th and final report on a research program to develop techniques for cladding heavy gage steels with stainless steel recapitulates experimental conditions, gives data on welding currents, composition of SS tapes used, fluxes, and slags, and summarizes the factors which influence the chemical composition of claddings produced by this method. NSA

N69-17139# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
COMPLEMENTARY OBSERVATIONS CONCERNING CAST GRAIN REFINING IN URANIUM ALLOYS. INFLUENCE OF SMALL ADDITIONS [OBSERVATIONS COMPLEMENTAIRES SUR L'AFFINAGE DU GRAIN DE COULEE D'ALLIAGES D'URANIUM]
Michel Colombie, Jacques Decours, Michel Foure, and Pierre Magnier Jul. 1968 25 p refs In FRENCH
(CEA-R-3529) Avail: CFSTI

The advantages of refining the primary γ crystallization in uranium and its alloys are presented. The refining or the control of the γ grains can be obtained either by modifying the solidification kinetics, or by the addition of very small amounts of alloying elements. The second method is considered and particular attention

paid to the refining role played by elements of low atomic number. The presence of carbon in concentrations of less than 1000 × 10^{-6} in U–Mo alloys leads to a definite refining effect on the primary γ crystallization. For a given rate of solidification, this effect is a maximum for a carbon content of between 500 and 800 × 10^{-6}. The importance of this maximum decreases with the cooling rate; it is very marked for fast rates and disappears in the case of low cooling rates. The addition of carbon gives rise to the formation of uranium carbides whose nature and dispersion state depends on the solidification kinetics. Author (NSA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N69-16150 Ohio State Univ., Columbus.
MICROPOROSITY EFFECTS ON MECHANICAL AND ELECTRICAL BEHAVIOR OF SINTERED CERAMICS
Joseph Nicholar Panzarino (Ph.D. Thesis) 1967 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-8865

Standard sintering techniques were employed to produce specimens representing both a completely crystalline and highly glassy system, using magnesia–alumina and nephelite syenite compositions respectively. Elasticity, mechanical strength, dielectric strength and dissipation factor results indicated a sensitivity to microporosity. A modification to accepted exponential strength and elasticity relations with porosity to include both the effects of open pores and micropores was clearly indicated. Dielectric constant showed no special sensitivity to micropores and followed the accepted linear relation with porosity. Anomalously high modulus of rupture values were obtained for groups of specimens in both glassy and crystalline systems having a very small open pore phase, in conjunction with microporosity. The higher-fired glassy specimens exhibited anomalously high dielectric strengths and dissipation factors, implying a possible sensitivity to phase changes and complete surface sealing. Dissert. Abstr.

N69-16325# General Technologies Corp., Reston, Va.
MAP COATING CONCEPT STUDIES Final Technical Report, Nov. 1967–Oct. 1968
Edwin F. Abrams Oct. 1968 78 p refs
(Contract DAAK02-68-C-0163)
(AD-679215; GTC-133.7-1) Avail: CFSTI CSCL 11/3

The purpose of this investigation was to perform concept studies and necessary supporting experimentation pertaining to the use of protective map coatings by the Army base plants and or field topographic units for the purpose of defining the optimum coatings and coating techniques from the standpoints of durability, effectiveness and cost. The results of the laboratory evaluation yielded ten coating materials that satisfied the technical requirements. Abrasion due to annotation removal and microbial attack were found to be the major causes of map deterioration. Due to other factors involving equipment limitations, logistics and cost, the selection of one optimum coating was possible. It was concluded that a water-base post cross-linking terpolymer, SB-727, was the optimum coating to be applied with the latest design Marcote coating machine. Author (TAB)

N69-16326# Cekmece Nuclear Research Center, Istanbul (Turkey).
ULTRASONIC DETERMINATION OF THE ADIABATIC COMPRESSIBILITIES OF LUBRICATING LIQUIDS
Ertugrul Yazgan Sep. 1968 26 p refs
(CNAEM-60) Avail: CFSTI

A study was made on the effect of temperature and pressure on the velocity of sound in a number of lubricating fluids of practical interest. The results are discussed with regard to the feasibility of using ultrasonic measurements for the determination of the adiabatic compressibility. An attempt was also made to find an empirical relationship which may be used to predict the velocity of sound in a liquid as a function or pressure. Author

N69-16442 University of Southern Calif., Los Angeles.
ELASTIC-PLASTIC RESPONSE OF A CLASS OF REINFORCED COMPOSITE MATERIALS
Angelo Anthony Caputo (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-10223

A class of reinforced composite materials, represented by a reinforced solid propellant, which has an initial elastic response followed by an appreciable plastic response to applied loads was studied. The materials were assumed to manifest orthotropic symmetry throughout the behavior range under consideration. The propellant chosen was a standard formulation with the exception that helically wound aluminum wires replaced the usual aluminum powder. The theoretical constitutive relations were seen to provide close fit to the experimental stress-strain curves. The boundary value problem of a thick wall reinforced propellant cylinder subjected to internal pressure was formulated. Solutions were obtained using the nonlinear yield surface and considering the material to be both perfectly plastic and hardening, as well as for a linearized approximation to the nonlinear yield surface. Perfectly plastic and hardening cases were considered. Finally, the nonlinear partial differential equation system governing the hardening case was solved numerically for a representative propellant geometry. The approaches have an applicability that extends well beyond the reinforced solid propellant system used. Dissert. Abstr.

N69-16829# Society of Plastics Engineers, Inc., New York.
PLATING ON PLASTICS 2
1968 85 p refs Presented at the Regional Tech. Conf., New Haven, Conn., 4–5 Dec. 1968
Avail: Issuing Activity

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9. MEANINGFUL STANDARDS FOR PLATED PLASTICS: A SUMMARY OF ASEP AND ASTM PROGRESS T. E. Wallis (Jamison Plastic Corp.) p 62–66 (See N69-16838 06-18)

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12. PLATING ON PLASTICS—A PRAGMATIC LOOK AT THE PROBLEMS S. E. Beacom (Gen. Motors Res. Labs.) p 71–83 refs (See N69-16841 06-15)

N69-16830# General Electric Co., Louisville, Ky.
OBJECTIVE COMPARISON OF VARIOUS PLATABLE PLASTICS SUBSTRATES FOR APPLIANCE BACKSPLASH PARTS
R. E. Eshenaur, J. L. Isaacs, and W. C. Robb *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 1–15 ref (See N69-16829 06-18)
Avail: Issuing Activity

Seven plastics substrates (two acrylonitrile butadiene styrene (ABS), four polypropylene and one impact polystyrene), all plated by commercially available plating processes, were evaluated as replacements for plated zinc die cast parts. From an over-all performance standpoint, plated polypropylene gives better performance than plated ABS or polystyrene. The polypropylene was especially superior where high temperature and/or humidity were present. One polypropylene gave the best general performance and is to be considered further for severe applications, and other substrates performed well enough to be considered for less critical applications. Test results also indicated that plating thickness had a large effect of performance, but attempts to evaluate this effect were hindered by the inconsistent quality of the plating. It was concluded that further work is necessary before using large plastic parts in production, particularly in the area of modification to the mold and standardization of molding and plating. Author

N69-16831# Avisun Corp., Marcus Hook, Pa.
MOLDING AND QUALITY ANALYSIS OF POLYPROPYLENE SUBSTRATES
Evan B. Ewan *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 16–25 refs (See N69-16829 06-18)
Avail: Issuing Activity

Factors which must be considered in producing a superior electroplated polypropylene part are discussed. Polypropylene parts offer better economy and quality over other types of electroplated plastics available commercially, particularly in metal-to-metal adhesion, thermal cycling, high temperature, and low water absorption characteristics. It is emphasized that production of these superior parts depends on both part and mold design and the selection of proper processing conditions. Mold design considerations include elimination of potential sink areas which would impair appearance. Large gates and runner systems are equally important to minimize stress development in the molded part. Minimizing of stress to produce better platability is contrary to processes for molding conventional polypropylene. If some compromises are therefore necessary, molding conditions which are the most important for preventing stress are slow injection time, medium to medium-high melt temperature, and low injection pressure. Annealing of highly stressed unplatable polypropylene parts will render them platable. A.C.R.

N69-16834# Enthone, Inc., New Haven, Conn.
PREPLATE SYSTEMS FOR POLYPROPYLENE
E. B. Saubestre *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 40–43 (See N69-16829 06-18)
Avail: Issuing Activity

Since the exact manner in which metals adhere to plastics is not yet known, the preliminary theories are discussed in two broad categories: mechanical theory and chemical theory. Based upon the two theories, conditioners and etchants for polypropylene are discussed and compared with those for acrylonitrile butadiene styrene (ABS). The difference in conditioning is based on the presence of more double bonded carbons on the surface of ABS than on polypropylene, making the latter less susceptible to chemical oxidation treatments. However, it is found that once the polypropylene surface has been properly conditioned, it may then be treated exactly as an ABS surface through subsequent processing. Tests indicate that adhesion values with polypropylene are significantly higher than for ABS. The lower degree of chemical degradation in polypropylene surface layers, a phenomena which is consistent with the earlier observation that polypropylene is harder to oxidize than ABS, is apparently the cause for the difference. A.C.R.

N69-16838# Jamison Plastic Corp., North Bellmore, N. Y.
MEANINGFUL STANDARDS FOR PLATED PLASTICS—A SUMMARY OF ASEP AND ASTM PROGRESS
Thomas E. Wallis *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 62–66 (See N69-16829 06-18)
Avail: Issuing Activity

Progress in establishing industry standards in the field of electroplated plastics is discussed. One of the basic problems is the complex nature of the overall process of molding and plating as related to the myriad of base materials and applications. In order to overcome this problem, representatives from all areas of the industry were recruited and organized into groups, with the sole purpose of establishing communication with industries having similar performance requirements. The four groups are (1) automotive, marine; (2) plumbing and building; (3) major appliance; and (4) miscellaneous tool, hardware, mechanical and electrical manufacturers. Committees were formed then to concentrate on three major problem areas: adhesion, appearance, and corrosion resistance. Another committee is being to write the specifications and specify the tests to be conducted in order to establish industry-wide standards. Organizational work is continuing toward forming additional committees to investigate the more specific problem and test areas. A.C.R.

N69-16839# Westinghouse Electric Corp., Pittsburgh, Pa.
FUTURE OF PLATED PLASTICS IN APPLIANCES
Don M. Courtad *In* Soc. of Plastics Engr., Inc. Plating on Plastics 2 1968 p 67 (See N69-16829 06-18)
Avail: Issuing Activity

Possible uses of electroplated plastic parts in the appliance industry are enumerated. A.C.R.

N69-16868*# Lockheed Missiles and Space Co., Palo Alto, Calif. Thermophysics Lab.
STUDY OF ENVIRONMENTAL EFFECTS UPON PARTICULATE RADIATION INDUCED ABSORPTION BANDS IN SPACECRAFT THERMAL CONTROL COATING PIGMENTS Final Report, 22 May 1967–27 Jan. 1969
27 Jan. 1969 111 p refs
(Contract NAS2-4353)
(NASA-CR-73289; Rept-6-78-68-45) Avail: CFSTI CSCL 11C

Studies of the effects of a simulated solar wind environment (solar ultraviolet and solar wind protons) were made on ZnO/K_2SiO_3 and La_2O_3/K_2SiO_3 thermal control materials. In situ optical measurements were made to establish the change in optical

characteristics of both materials, as a function of proton energy and substrate exposure temperature. The proton energies were 500, 1200, and 3200 eV and the exposure temperatures 77°, 298° and 423°K. Both materials exhibited a recovery effect (as measured in situ), the magnitude of which was energy and temperature dependent. Proton-plus-ultraviolet and ultraviolet-only exposures were performed with electromagnetic radiation greater than 0.4 μ less than 0.4 μ and a combination of the two. The temperature-dependent studies were carried out at the same temperature levels as for the proton only exposures. The ZnO/K_2SiO_3 suffered a small amount of damage, comparable to that experienced for a proton-only environment. The La_2O_3/K_2SiO_3 suffered drastic degradation, which was greatest at the higher exposure temperature. A theoretical study of low energy proton ranges and modes of energy dissipation was conducted. The results are discussed relative to the behavior of the two materials in the proton only environment. Author

N69-16870*# Pennsylvania State Univ., University Park.
MECHANICAL CHARACTERIZATION OF SOLITHANE 113
M. G. Sharma and Y. S. Lee Nov. 1968 59 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950875)
(NASA-CR-73645; TR-6) Avail: CFSTI CSCL 11J

The report describes two types of biaxial stress experiments to characterize Solithane 113 corresponding to time independent mechanical behavior. The first type of experiments were conducted under controlled strain rates and the second under controlled stress rates. A method has been described in this report to obtain the strain energy function for the material from the biaxial experimental results that included time effects. Results indicate that Solithane 113 after it reaches mechanical equilibrium can be characterized by a simple strain energy function that follows from the well known kinetic theory of rubber elasticity. Author

N69-16874# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
DEVELOPMENT OF ADHESIVE-BONDED JOINTS FOR GLASS RESIN COMPOSITE SANDWICH STRUCTURES
Samuel F. Lutters and Maron J. Bonasser Dover, N. J. Picatinny Arsenal Aug. 1968 62 p
(Contract DAAA21-67-C-0830)
(AD-678501; PA-TR-37-34) Avail: CFSTI CSCL 11/4

The structural efficiencies of fiberglass resin composite structures were established for various adhesive bonded joint designs. The program covered three separate phases; design, fabrication and static testing of sandwich panels to determine their ability to take shear, tension, bending, and compression loads. Author (TAB)

N69-16884# Norton Research Corp., Cambridge, Mass.
INVESTIGATION OF COMPOSITE STRUCTURES FABRICATED WITH ADVANCED HIGH-STRENGTH, HIGH-MODULUS REINFORCEMENT MATERIALS
Earl E. Chadsey, Jr., Gabriel E. Padawer, and Frank Feskes Aug. 1968 45 p refs
(Contract DAAJ02-67-C-0091)
(AD-678641; USAAVLABS-TR-68-56) Avail: CFSTI CSCL 11/4

Methods of making boron-plastic plane isotropic structural composites using boron film reinforcement were developed. Principal objective was to obtain high percentages of boron in the composite and values to 54% by volume were achieved. This resulted in elastic moduli up to 31,000,000 psi and tensile strengths up to 40,000 psi. The two fabrication techniques studies involved: (1) a 1/4 mil polyimide substrate for the boron film; (2) an aluminum substrate which was partially removed. Author (TAB)

N69-16965*# Martin Co., Denver, Colo.
EXPLORATORY EXPERIMENTAL STUDY ON NEUTRAL CHARGE LOW ENERGY PARTICLE IRRADIATION OF SELECTED THERMAL CONTROL COATINGS
Dennis Farnsworth Jan. 1969 24 p refs
(Contract NAS2-4962)
(NASA-CR-73290) Avail: CFSTI CSCL 11C

Four laboratory space environmental tests were conducted on two materials (ZnO and Al_2O_3) using both neutral and positive particulate beams to compare effects of a neutral (protons and electrons) particulate radiation flux on the specimens as opposed to a positive (proton) flux within set radiation levels. Isolation of synergistic effects was also attempted. Environmental exposure data is given in terms of spectral reflectance change at a given wavelength. Tentative findings show that: (1) No obvious relationship was identified to explain the disparity between flight and laboratory thermal control stability data. (2) Introduction of thermal electrons into the laboratory testing environment is a factor in costing damage as indicated by spectral reflectance changes. Major thermal electron effects were bleaching in the visible and infrared region for zinc oxide, semiconductor, pigmented potassium silicate costing, and bleaching in the near ultraviolet for aluminum oxide, dielectric, pigmented potassium silicate coating. E.C.

N69-17006# Princeton Univ., N. J. Frick Chemical Lab.
RUBBER ELASTICITY
Arthur V. Tobolsky Nov. 1968 32 p refs
(Contract N00014-67-A-0151)
(AD-679235; ONR-TR-RLT-109) Avail: CFSTI CSCL 11/10

The report presents a general review of the theory of rubber elasticity including many recent developments. Author (TAB)

N69-17007# Eastman Chemical Products, Inc., Kingsport, Tenn.
PROPYLENE POLYMERS FOR INSULATION OF COMMUNICATION CABLE
B. V. Harris Dec. 1968 29 p
(AD-678693) Avail: Issuing Activity CSCL 11/9

Polyolefins have long been recognized as a very fertile field in which to search for plastic dielectrics. Some of the reasons for this fact include the availability of these materials in large quantities from numerous suppliers; their relatively low price, which makes them attractive for large-volume applications; and their excellent electrical insulating properties, resulting in part from their high degree of nonpolarity. Originally, low-density polyethylene was used exclusively among the polyolefins for this application. The promise of better mechanical properties led to the introduction of high-density polyethylene, sometimes called linear polyethylene, for both insulation and jacketing of wire and cable. Both high- and low-density polyethylene are currently in wide use for these applications. Low-density polyethylene is most frequently used for conductor insulation while high-density polyethylene is more widely used as a jacketing compound, reflecting the relative strong points of the 2 materials. Polypropylene has better electrical properties than either high- or low-density polyethylene. It also has a much higher glass-transition temperature, however, which results in more brittleness than is found in polyethylene. Initially this brittleness caused the rejection of polypropylene in most electrical applications. Further work has largely overcome the brittleness problem through the development of impact-modified polypropylenes and propylene-ethylene copolymers, a new class of materials also included under the general heading of propylene polymers. Author (TAB)

N69-17116# Gulf General Atomic, San Diego, Calif.
EMPIRICAL CORRELATIONS OF PROPERTIES OF GRAPHITES

C. Meyers 9 Jul. 1968 36 p refs
(Contract AT(04-3)-633)
(GAMD-8738) Avail: CFSTI

Property data on grades of graphites studied for applications in Fort Saint Vrain Reactor have been examined for parametric correlations. Those in which such relationships were found are reported for use as a guide to assist design groups in making engineering estimates of the properties of graphites in general.
Author (NSA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N69-16119 Rochester Univ., N. Y.
LIAPUNOV FUNCTION GENERATION FOR AUTONOMOUS SYSTEMS
Chiou-Shiun Chen (Ph.D. Thesis) 1968 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-9358

A reduction technique is presented for determining the sign definite property of higher order polynomials in n variables. The reduction is to a quadratic form in new variables such that Sylvester's theorem is applicable. A series correction method is described for sequentially developing a quadratic polynomial into a possible Liapunov function for a class of differential equations. This class of differential equations is autonomous and time invariant with a nonlinearity expressible in power series form of the variables.
Dissert. Abstr.

N69-16123 State Univ. of Iowa, Iowa City.
MODELING NONSTATIONARY RANDOM PROCESSES WITH AN APPLICATION TO GYRO DRIFT RATE
Albert John Van Dierendonck (Ph.D. Thesis) 1968 75 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-10488

The problem of estimating the a priori statistics of a nonstationary random process is considered. A new technique for modeling nonstationary random processes assumes that the nonstationary process being investigated can be thought of as the result of passing stationary ergodic "white noise" through a time-invariant linear filter. This technique requires no ensemble averaging; instead, time averages of products of the process at different times are performed. These averages are then used in a steepest descent method to determine the coefficients of a difference equation with a "white noise" sequence forcing function to describe the process at discrete times. This technique would not be feasible if time averages had to be computed for each iteration of the steepest descent calculations. The above techniques are applied to three records of actual gyro drift rate measurements with satisfactory results.
Dissert. Abstr.

N69-16134 Princeton Univ., N. J.
OPTIMAL CONTROL OF DISTRIBUTED-PARAMETER SYSTEMS
John Hersh Seinfeld (Ph.D. Thesis) 1967 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-8961

Optimization in nonlinear hyperbolic and parabolic systems are considered with boundary conditions containing a control. The variational theory is presented for these systems initially and the solution of the n-dimensional nonlinear distributed-parameter control problem is computed. A direct search on the performance index and a method of steepest ascent are derived for the solution of the two point boundary value problem in functional space. In addition, a differential difference approximation to the system of partial differential equations is shown to give excellent results for a class of linear systems with quadratic performance criteria. Quasilinearization and invariant imbedding are extended to distributed systems but shown not as feasible as the above three methods. Four examples, one dimensional transient heating, the optimal heating of a thick slab, optimal control of a double pipe heat exchanger, and the optimal cooling profile in a tubular reactor, are used to illustrate the results. The concept of controllability and the question of closed loop control are also discussed.
Dissert. Abstr.

N69-16177# Aeronautical Research Labs., Melbourne (Australia).
SEQUENTIAL TESTING OF THE STANDARD DEVIATIONS OF TWO DIMENSIONAL NORMAL DISTRIBUTION
S. Pelczynski May 1968 27 p refs
(ARL/A-302) Avail: CFSTI

The theory of sequential testing applied to bivariate normal distribution. Various testing procedures were investigated in relation to special cases of the general bivariate normal distribution.
Author

N69-16202 Washington Univ., St. Louis, Mo.
PURSUIT-EVASION DIFFERENTIAL GAMES
John Bernard Berger (Ph.D. Thesis) 1968 122 p
Avail: Univ. Microfilms: HC $6.00/Micrifilm $3.00 Order No. 68-10790

Differential game theory is applied to several classes of pursuit-evasion problems in which the dynamics of the participants are described by linear nonstationary differential equations. The differential endgame, where the evader has to out maneuver a pursuer, if it is to strike the target that the pursuer is defending is studied. The necessary and sufficient conditions for the existence of a saddle point, and the participants' control algorithms are determined. For a class of differential games, which results when the evader's target constraints and postengagement flight time are not considered, it is shown how the relationships that determine the intercept time, and the pursuer's initial state are used in deterimining when the pursuer is launched. Another class of differential games, where an additional pursuer is cooperating with the primary pursuer that is trying to intercept the evader is also studied. The two point boundary value problem is derived and solved.
Dissert. Abstr.

N69-16206 Illinois Univ., Urbana.
TRANSFINITE SEQUENCES OF AXIOM SYSTEMS FOR SET THEORY
Gilbert Leinbaugh Sward (Ph.D. Thesis) 1967 71 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-8241

It is appropriate to strengthen the axiom system by adding to it some sentences of set theory which are intuitively true. Certain transfinite sequences of axiom systems for set theory are studied. The transfinite sequences begin with the axiom system S_0 for Zermelo-Fraenkel set theory. The rule for passing from each axiom system S_α to the next $S_{\alpha+1}$ is that $S_{\alpha+1}$ is obtained from S_α by adding the sentences of set theory which collectively express the soundness of S_α.
Dissert. Abstr.

N69-16246# McDonnell Douglas Co., Santa Monica, Calif. Information Systems Subdiv.
EXTENDED ITERATIVE WEIGHTED LEAST SQUARES: ESTIMATION OF A LINEAR MODEL IN THE PRESENCE OF COMPLICATION

A. F. Goodman Jan. 1969 56 p refs Submitted for publication (Douglas-Paper-5205) Avail: Issuing Activity

An extended iterative weighted least squares procedure (EIWLS) is introduced for solution of a classical problem in analysis of scientific and technical information: estimation in the presence of complications, of the coefficients for linearly independent component signals in a linear model, from observations on the component signals and a composite signal containing the linear model plus noise which is nonstationary and/or correlated with unknown covariance matrix. An iterative weighted least squares procedure (IWLS) is developed for estimation in the absence of complications. Then IWLS is extended to perform the estimation subject to: (1) estimators being consistent with a priori information describing the random variation of coefficients over all possible states of nature (e.g., all systems of a specified type from a production process); (2) utilization of data from all pertinent channels in the estimation of coefficients which appear in the linear models for more than one data channel; and (3) replacement of the linear model by a new linear model containing only representative component signals which are highly descriptive, but not highly related, when there is a large number of component signals in the linear model and some of them are highly related. FORTRAN computer programs have been written to implement IWLS and EIWLS on the IBM 7094 for the case of nonstationary and uncorrelated noise. Author

N69-16276 Pennsylvania Univ., Philadelphia. Graduate School of Arts and Sciences.

A REPRESENTATION TECHNIQUE FOR SYSTEMS OF INTERACTING ALGORITHMS

Giorgio Ingargiola (Ph.D. Thesis) 1967 133 p

Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-9207

The present dissertation presents a simplified form of a potential computing system, designed to be expandable to the capability of simplifying the description and simulation of a class of self-organizing systems, and of examining some of the problems that would then arise and some of the requirements which, then, would have to be met. It is shown that in such a computing system it is possible, and with ease, to re-obtain all the results attainable in cellular models and, in particular, to describe self-reproducing automata and universal-constructor automata. Dissert. Abstr.

N69-16293 Columbia Univ., New York.

SOME THEOREMS ON COHOMOLOGY OF GROUPS WITH APPLICATIONS

Peter Michael Curran (Ph.D. Thesis) 1968 51 p

Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-8574

If R is a commutative ring with unity, M a free R-module of finite rank, and G a group which acts on M, cohomology modules may be defined in the usual way. These are studied in several cases. Some general theorems on cohomology of groups are obtained and applied to the case where G is a subgroup of GL(n,R) (n is the rank of M), acting in the natural way. For example, if G contains all scalar matrices, it is shown that the ideal N generated by all elements 1-u, u a unit in R, is contained in the annihilator of $H^r(G,M)$ for all r. R is then specialized to be the ring of integers in a number field, and arithmetic criteria are obtained for the vanishing of $H^2(G,M)$, when G is a certain subgroup of GL(n,R). Cyclotomic and quadratic fields are studied as special cases of the general theory. Dissert. Abstr.

N69-16296 Syracuse Univ., N. Y.

FORMAL METHODS FOR DERIVING EQUIVALENT ALGORITHMS

Walter Scott Bennett, Jr. (Ph.D. Thesis) 1967 94 p

Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-7767

The objective of this dissertation is to develop formal methods for deriving algorithms which are equivalent to a given algorithm. Complete equivalence of flow diagrams is defined and a number of axioms and theorems are then presented for transforming a given flow diagram into another flow diagram to which it is completely equivalent. Complete equivalence of flow diagrams is too strong to permit significant differences to exist between completely equivalent flow diagrams. Therefore, functional equivalence of flow diagrams is defined and a number of axioms and theorems are presented for carrying out transformations which preserve functional equivalence on members of a particular subclass of flow diagrams. This system of transforming flow diagrams is considered to be worthy of further study with regard to the size of the subclass of flow diagrams to which it is applicable and to its practical utility as a design tool. Dissert. Abstr.

N69-16297 Illinois Univ., Urbana.

EXTREME POSITIVE LINEAR OPERATORS

James Allen Crenshaw (Ph.D. Thesis) 1967 134 p

Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-8044

This paper is concerned with the extreme points of certain convex sets of positive linear operators from one ordered real vector space to another. In the first part the indecomposable elements (the elements which lie on extreme rays in the positive cone) are studied. In the case where E is a vector lattice and F is an order complete vector lattice, a complete characterization of the indecomposable elements in $L^b(E,F)$ is given. Results concerning the connection between indecomposability and order continuity are also established. In the second part the indecomposable elements are used to define an atomic subspace, and a diffuse subspace. The third part of this study is concerned with special features of the theory that are valid for (AL)-spaces or (AM)-spaces. If L_1 and L_2 are (AL)-spaces with bases B_1 and B_2, respectively, and if M_1 and M_2 are (AM)-spaces with order units e and u, respectively, then several convex sets are defined. Dissert. Abstr.

N69-16303 Illinois Univ., Urbana.

VARIABLE SUCCESSIVE OVER RELAXATION

Leland Kitchin McDowell (Ph.D. Thesis) 1967 62 p

Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-8162

This thesis investigates the solution of linear systems by extrapolated Gauss-Seidel iteration using a multiplicity of extrapolation parameters. The linear systems considered are those which arise in the numerical solution of boundary value problems for self-adjoint, elliptic partial differential equations. It is shown that the use of two appropriately chosen scalar extrapolation factors yields an iteration having a higher rate of convergence than SOR, and formulas are derived for choosing the factors optimally. Also, it is shown that by the use of extrapolation matrices, an iteration can be constructed whose matrix rate of convergence is infinite. A more limited class of linear systems considers a certain sort of spectral decomposition. For the solution of such systems the SEI and VSEI methods are introduced and shown to be equivalent to several simultaneous extrapolated Gauss-Seidel iterations on certain subspaces, each with a different extrapolation factor or set of factors. Dissert. Abstr.

N69-16304 Oklahoma State Univ., Stillwater.

A STUDY OF ORBITS AND TRANSITIVE CONTINUOUS FUNCTIONS

Wilchor David Moon (Ph.D. Thesis) 1967 52 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-8463

This paper deals with the orbit of points under a transitive continuous function. The concept of transitive continuous functions is defined and some fundamental properties are investigated. A study is made of the limit set of a closed component orbit under a continuous function. Some elementary theorems which characterize transitive continuous functions are developed. These are then used to exhibit several important examples of transitive continuous functions, one on the closed unit interval, one on the open unit interval and the existence of one on the real line. Also included is a collection of results on F-invariant open sets and F-invariant closed sets. The theorem of Schweigert is proved for compact metric spaces and pointwise periodic transformations. An example of a continuous, componentwise periodic, monotone transformation which is not pointwise periodic is given. Dissert. Abstr.

N69-16327# Boston Coll., Chestnut Hill, Mass. Space Data Analysis Lab.
SCIENTIFIC RESEARCH IN THE FORM OF NUMERICAL ANALYSIS AND DATA ANALYSIS Final Report, 1 Apr.-31 Dec. 1967
Richard W. Doherty, Joseph F. Russell, and Rose M. Ring 31 Jan. 1968 53 p refs
(Contract F19628-67-C-0315)
(AD-678556; AFCRL-68-0481) Avail: CFSTI CSCL 12/1

The report summarizes the data analysis, numerical analysis and programming performed in the solution of varied scientific problems during this year. These problems range in complexity from the numerical approximation of complicated double and triple integrals and numerical solutions for systems of non-homogeneous equations and the root solutions of cubic and quintic equations with varying coefficients. Each problem encountered is presented in capsule form and its solution is outlined. It should be noted that, as of this report, a number of these problems because of their complexity and continuing character are still being analyzed. Author (TAB)

N69-16364# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
ON ESTIMATING THE PARAMETER OF A TRUNCATED GEOMETRIC DISTRIBUTION
R. L. Thomasson and C. H. Kapadia 6 Sep. 1968 11 p refs
(Contract N00014-68-A-0515; Grant NIH GM-951)
(AD-678785; TR-5) Avail: CFSTI CSCL 12/1

The paper is concerned with the problem of maximum likelihood estimation for the parameter, of the geometric distribution, from samples which are truncated at arbitrary points in either or both tails of the distribution. It is shown that the maximum likelihood estimator is the solution of a polynomial of high degree, and a table is given for solving the maximum likelihood estimating equation. The derivation of the asymptotic variance of the estimator is presented and the result is used in the study of the asymptotic efficiency of the estimation in truncated sampling. The efficiency of the maximum likelihood estimator for complete samples is derived and it is shown that the estimator based on truncated samples always provide less information about the parameter than that based on complete sample of the same size. Author (TAB)

N69-16372# Research Analysis Corp., McLean, Va.
LAGRANGE MULTIPLIERS AND NONCONVEX PROGRAMS
James E. Falk Nov. 1968 24 p refs
(Contract DA-44-188-ARO-1)
(AD-678570; RAC-TP-336) Avail: CFSTI CSCL 12/2

The paper contains two new theoretical results that have implications in nonlinear programming. The first result stems from a generalization of the notion of 'conjugacy' and yields the fact that the second conjugate of a nonconvex function is essentially identical to the convex envelope of that function. This is used to obtain the second result, which illustrates the reasons for the failure of the Lagrange multiplier technique on certain nonconvex programs. It is shown that the application of this technique optimizes the convex envelope of the objective function rather than the objective function itself. Author (TAB)

N69-16374 Clemson Coll., S. C.
ON RANDOM NORMED SPACES
Bobby Joseph Prochaska (Ph.D. Thesis) 1967 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-9024

Questions concerning the basic theory of random normed spaces are answered. A characterization of the ϵ,δ-topology is given as a weak linear (vector) topology induced by the random norm function. After proving that all random normed spaces are T_1-spaces, it is proved that all random normed spaces are metrizable with an invariant metric. It is also demonstrated that every finite dimensional random normed space is normable. In general it is not known if random normed spaces are locally convex. Sufficient conditions are given for which the ϵ,δ-topology is locally convex. This result leads to a characterization of normability of random normed spaces. Dissert. Abstr.

N69-16394 Michigan Univ., Ann Arbor.
ALGEBRAIC ISOMORPHISM INVARIANTS FOR TRANSITION GRAPHS
John Frederick Meyer (Ph.D. Thesis) 1967 192 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-7671

Transition graphs, which correspond to partial transformations on a finite set, are studied from an algebraic point of view in terms of a "natural" representation of the graphs by linear transformations. The classical invariants of linear transformation similarity become invariants of graphical isomorphism. The investigation was to determine the extent to which these algebraic invariants specify the structure (isomorphism class) of an arbitrary transition graph. Connected graphs are studied and solved in terms of a procedure by which the invariant polynomials of a representing linear transformation can be determined directly from the structure of the corresponding graph. Multicomponent graphs are then considered, and here the problem decomposes rather naturally into a study of two extreme cases, "permutation graphs" and "forests." By combining these results and solving for the graphical invariants in terms of the elementary divisors, for an arbitrary transition graph, the precise extent of the structural information conveyed by these algebraic isomorphism invariants can be determined. Dissert. Abstr.

N69-16409 California Univ., Berkeley.
IDENTIFICATION PROBLEM AND RANDOM CONTRACTION MAPPINGS
Kandrap Oza (Ph.D. Thesis) 1967 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-10390

The problem of identification of systems characterized by certain parameters are considered. Iterative method for estimating these parameters on the basis of noise-corrupted input-output data is presented. Since any iterative scheme dealing with random variables can be considered as a stochastic approximation procedure, a brief account of such procedures is given. The random contraction mappings and related iterative schemes are considered in order to overcome certain technical difficulties associated with the usual stochastic approximation. An extension of one of Han's random fixed point theorems is presented. The problem of identifying parameters

of a single-input single-output discrete system is reduced to solving a set of regression equations. The estimates of certain correlation functions appearing as coefficients in these equations are constructed from the input–output data and their convergence with probability one is established using results of time series analysis.
Dissert. Abstr.

N69-16450 Michigan Univ., Ann Arbor.
INVARIANT MEANS
Myren Laurance Krom (Ph.D. Thesis) 1967 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-7650

Let G be a semigroup, B(G) the space of all bounded real valued functions with domain G. B(G) with the supremum norm is a Banach space. If a positive, linear functional of norm one on B(G) is invariant under left and right translations by elements of G then it is called an *invariant mean* on B(G). If G is a finite commutative group then there is exactly one invariant mean on B(G). If G is an infinite commutative group then there is a continuum of invariant means on B(G). If G is any commutative group and f is a function in B(G), then there are two real numbers I_f and S_f (which may not be distinct) such that a real number t is the value of some invariant mean at f iff $I_f \leq t \leq S_f$. For any function f the numbers I_f and S_f are expressed in terms of f and its translates. The set of all invariant means on B(G) is a w*-closed convex set in B(G)*.
Dissert. Abstr.

N69-16451 Oklahoma State Univ., Stillwater.
THE MULTIPLE RESPONSE PROBLEM
Howard Leland Dockery (Ph.D. Thesis) 1967 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-8389

The problem of maximizing a single function of a vector X was extended to treat situations when there were multiple responses of interest. Because of their use in building statistical models, special consideration was given to response functions which have families of quadratic curves as their contours. It was found that if the response functions satisfied certain conditions the domain of the functions could be partitioned into two sets. One of the sets (the complete set, A,) had the property that for every X in A there exists a point in A which was better. When the contours of the response functions formed families of quadratic curves, it was determined if the set of admissible points exists. If the set of admissible points did exist, the set of admissible points was obtained.
Dissert. Abstr.

N69-16452 Oklahoma State Univ., Stillwater.
THEORY OF MAXIMA AND MINIMA AND APPLICATIONS
Marcus Harold Whitfield, Jr. (Ph.D. Thesis) 1967 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-8523

The theory of maxima and minima is logically developed and illustrated from the standpoint of differential calculus and from the standpoint of calculus of variations. In differential calculus, the study includes functions of one variable, functions of two variables, functions of three or more variables, and Lagrange's multipliers. In calculus of variations, the study includes the fundamental theory of the calculus of variations with emphasis on the simplest variational problems with fixed endpoints, first variation, second variation, quadratic functionals, and constrained variational problems. A real-valued continuous function defined on a closed interval has both an absolute maximum and an absolute minimum. Necessary conditions for a functional to have an extremum are summarized.
Dissert. Abstr.

N69-16477*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPUTATION AND ANALYSIS
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 16-21 refs (See N69-16475 08-07)
Avail: CFSTI CSCL 12A

The direct summation of series involving higher transcendental functions is described mathematically, and the recurrence relations for the computation of many functions are discussed. Also presented are some numerical experiments using a generalized algorithm for summing a Chebychev series directly which was applied to a simple series. Further consideration is given to the integrals of confluent hypergeometric functions. The problems of fitting curves to discrete data and approximating continuous functions were surveyed. It is pointed out that the choice of a mathematical model in an approximation problem can often be described as the choice of form such as polynomial, rational, or spline, and the choice of norm. Constraints and transformation of variables must also be taken into account. If the problem objectives offer some freedom in the choice of form or norm, the decision should be made on the basis of such properties as numerical stability and economy of computation. These properties are discussed in relation to fitting functions of two or more real variables or complex variables.
M.G.J.

N69-16499 Pennsylvania Univ., Philadelphia.
PRACTICAL IDENTIFICATION OF A LINEAR SYSTEM FROM DISCRETE VALUES OF INPUT–OUTPUT DATA
Shui Yee Lee (Ph.D. Thesis) 1967 220 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-9215

In many branches of science there are situations where the input and the output of a linear system are known as recorded curves or as digital samples obtained at a uniform time interval. A method of identifying such a system in terms of the poles, the zeros, and the gain of the transfer function between the input and the output has been analyzed by C. N. Weygandt and N. N. Puri. This thesis describes an extension of their method in light of new theoretical considerations. Practical problems having periodic as well as aperiodic input–outputs, have been investigated through the use of a digital computer. In a matter of a few seconds, a rational function approximation for the complete transfer function of a given system can be determined.
Dissert. Abstr.

N69-16501 Wesleyan Univ., Middletown, Conn.
AN ALGEBRAIC APPROACH TO THE STUDY OF MINIMAL SETS IN TOPOLOGICAL DYNAMICS
Brindell Horelick (Ph.D. Thesis) 1967 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 67-17662

It is known that the minimal sets (X,T) with compact Hausdorff phase space X and discrete group T correspond to certain subalgebras, that transformation group properties of the minimal sets are reflected in algebraic properties of the subalgebras, and that a neo-Galois theory can be imposed upon these subalgebras. The notion of pointed minimal set is defined and used to study this correspondence in detail. A characterization is obtained of the algebras corresponding to the minimal right ideals of a given (X,T). The concept of group-like extension, which arises in the neo-Galois theory, is studied intensively, and the maximal group-like extension of an algebra is exhibited. Regularity, endomorphisms and automorphisms of minimal sets, coalescence, equicontinuity and proximal equicontinuity are studied from the algebraic point of view, and regularity is generalized. An easy description is provided of all the groups which appear as automorphism groups for some regular minimal set (X,T) with a given phase group T.
Dissert. Abstr.

N69-16502 Maryland Univ., College Park.
A STUDY OF TOPOLOGICAL ABELIAN GROUPS BASED ON NORMED SPACE THEORY

Robert Clark Hooper (Ph.D. Thesis) 1967 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-6527

Locally convex topological groups are defined and some of their properties are examined. An example is given of a topological abelian group which is not locally convex and has concave properties. It is shown that locally convex groups G which are quotient groups of normed spaces are subgroups of the projective limit of groups G_α which are quotient groups of normed spaces by discrete subgroups. It is shown that connected groups G which have a basis of the identity of neighborhoods which are the intersection of weak neighborhoods, the strongly convex property, arise from topological vector spaces. Following the reduction of general problems to problems about quotient groups G of normed spaces E by a discrete group K, it is proved that if E/K is strongly convex, then E can be renormed so that its norm assumes integer values on K. Then going in the reverse direction, the definition is given of an integral norm. A duality theory is developed in terms of bounded integer valued homomorphisms. Dissert. Abstr.

N69-16508 Michigan Univ. Ann Arbor.
SINGULAR PERTURBATIONS OF CAUCHY'S PROBLEM
Bertrand Latil (Ph.D. Thesis) 1967 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-7655

The Cauchy problem is formulated, a theorem is stated, and previous solutions are discussed. A solution to the problem is constructed, where the integrands are precisely the solutions to the ordinary differential equations in the formulation. Using the Lebesgue dominated convergence theorem, the previous theorem is proved in the abstract setting. Dissert. Abstr.

N69-16509 Michigan State Univ., East Lansing.
INVERTING AND MONOTONE PROPERTIES OF COMPLEXES
Shashichand Fatehchand Kapoor (Ph.D. Thesis) 1967 61 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-7911

Doyle and Hocking introduced the concept of invertibility for topological spaces and then applied this idea to finite geometric simplicial complexes. Characterizations of 1- and 2-complexes with a single invert point were given by Doyle and Klassen respectively. Hocking proved that if K is a complex with $0 \leq \dim I(K) \leq \dim K$, then K is a multiple suspension. It is shown that if a complex K has $\dim |I(K)| \geq 1$, then $Cl(K) = I(K)$. Complexes are discussed with a single invert point by restricting the number of orbits under isotopy and by imposing the Brouwer Property on the complex. Invert sets of suspensions of complexes with a single invert point are considered. The concept of an expanding n-star graph E(n) as a monotone union of star graphs is introduced and shown that all such graphs can be embedded in a plane. This concept suggests a possible generalization of the self avoiding walks discussed by Kesten and generalizes a result of Doyle on complexes which are monotone unions of 1 cells. Dissert. Abstr.

N69-16510 Columbia Univ., New York.
A GENERALIZATION OF THE RIEMANN-ROCH-HIRZEBRUCH-GROTHENDIECK THEOREM
Philip Donald Wagreich (Ph.D. Thesis) 1967 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-8626

Suppose S is a regular noetherian prescheme unramified over Spec(Z), X and Y are smooth projective S-schemes and f: X → Y is an S-morphism. The goal of this dissertation is to prove a generalization of the Riemann Roch theorem for f. Dissert. Abstr.

N69-16512 Oklahoma State Univ., Stillwater.
CONVEXITY LATTICES RELATED TO TOPOLOGICAL LATTICES AND INCIDENCE GEOMETRIES
Samuel Horace Douglas (Ph.D. Thesis) 1967 41 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-8390

Incidence geometries are studied by considering properties of a lattice of subsets, called flats, in a manner similar to that used in topology. The object of this investigation is to pursue this approach for order and topological structures by studying lattices of subsets called convex sets, properly related to the flats in the incidence geometries, as well as related topologies and uniform structures, although the structures are more general than those of the topological real vector spaces, and each of the classical theorems which hold in these structures must be proved independently. It was found in this investigation that most of the classical separation theorems can be proved in an incidence geometry with the related convex sets and order structure. In most considerations, the vector spaces are special cases and the classical theorems automatically follow. Dissert. Abstr.

N69-16522 California Univ., Los Angeles.
SOME CONTRIBUTIONS TO NON-STANDARD ANALYSIS
Robert Gibson Phillips (Ph.D. Thesis) 1968 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-8781

Fundamental to non-standard analysis is the existence of proper ordered-field extensions of the real numbers. These extensions are necessarily non-archimedian and hence contain numbers which are infinitely small when compared to the ordinary real numbers. This led to reformulating some of the basic concepts of analysis. Dissert. Abstr.

N69-16532 California Univ., Berkeley.
SYSTEM REPRESENTATIONS
Dennis Jeffery Eggert (Ph.D. Thesis) 1967 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-10314

Three system representations are investigated: the Differential System (DS) characterized by a differential equation, the Relaxed Differential System (RDS) which is a modification of a DS, and the Generalized Dynamical System (GDS) characterized by an "attainability function" whose image is the set of attainable states of the system. This latter representation has had limited study and hence is of principal interest. Properties of these representations and relationships between them are developed. It is shown that the closure of the set of trajectories of a DS in the space of continuous functions is equal to the set of trajectories of the corresponding RDS and derived GDS. If the attainability function of a time invariant GDS possesses an affine-like property, there exists a unique linear DS equivalent to the GDS. Returning to the more general case, conditions for the existence of an equivalent time varying, nonlinear DS are developed. Whereas all the above results pertain to systems with finite dimensional state spaces, the results concerning the existence of an equivalent linear DS are extended to GDS's with reflexive Banach state spaces. Dissert. Abstr.

N69-16554 Illinois Univ., Urbana.
QUASI-DYNAMICAL SYSTEMS
Vladimir Drobot (Ph.D. Thesis) 1967 95 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-8054

The properties of the space-filling curves which are regular but not necessarily orientable are investigated. A space X, together with such a family of curves is called a quasi-dynamical system, and the curves in F are called the trajectories. It is shown that

many of the properties of ordinary dynamical systems hold also for the trajectories of quasi-dynamical systems. The proof that the arcs on the trajectories are well defined, i.e., depend only on the end points and not on the parametric representation of the trajectories is presented. A global theory of quasi-dynamical systems is developed. The concepts of limit cycles, invariant sets, wandering trajectories, stability in the sense of Lagrange and Poisson, and minimal sets are introduced and results similar to those in the theory of ordinary dynamical systems are proved. Several examples of quasi-dynamical systems which cannot be orientable are given, showing that quasi-dynamical systems are really a generalization of ordinary dynamical systems. Dissert. Abstr.

N69-16586 Michigan Univ., Ann Arbor.
SEMILINEAR MARKOV PROCESSES
Joseph Horowitz (Ph.D. Thesis) 1967 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-7631

An investigation was conducted on the analogy between semilinear Markov processes and the so-called spent waiting time processes which arise in classical renewal theory. Some applications of the results are given on semilinear processes to the theory of local times for Hunt processes, including a short proof of a theorem of Blumenthal and Getoor on the Lévy measure of the inverse local time. It is shown that the zero set of a strongly Markov semilinear process is a possibly unbounded Cantor-type set, thus generalizing a well-known result for Brownian motion to the class of Hunt processes with a regular, non-holding point at zero. Dissert. Abstr.

N69-16601# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS OF PROBABILISTIC AUTOMATA
M. K. Chirkov 26 Jan. 1968 7 p refs Transl. into ENGLISH from Vychislitel'naya Tekhn. i Vopr. Programmirovaniya (Leningrad), v. 4, no. 4, 1965 p 100–103
(AD-679369; FTD-HT-23-1353-67) Avail: CFSTI CSCL 9/2

Given a deterministic finite automaton A having M states and N inputs, and its binary realization R with I internal and Q input cells, it is required to find a probabilistic finite automaton Apr, the binary realization Rpr of which is obtained from R by replacing the deterministic cells with probabilistic ones. A theorem is presented stating that the elements of the transition matrices of Rpr may be decomposed into conditional probabilities of any of its M internal and N input cells. A second theorem is stated concerning the minimum probability of correct operation of the binary automaton. TAB

N69-16606 Oklahoma State Univ., Stillwater.
DERIVED FUNCTORS IN RELATIVE HOMOLOGICAL ALGEBRA
Franklin S. Brenneman (Ph.D. Thesis) 1967 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-8368

The theory of derived functors in relative homological algebra is developed and used to determine properties of the functor Cotor and to study the functor Coext. A product is obtained for each of these functors. Unless specifically stated otherwise, all algebras, coalgebras and modules are graded. Dissert. Abstr.

N69-16648# Pennsylvania Univ., Philadelphia.
A MATHEMATICAL MODEL FOR CHEMICAL CIPHER SYSTEMS 1
George Weaver Feb. 1968 34 p refs
(PB-179803) Avail: CFSTI CSCL 05B

The paper grew out of an attempt to formalize some existing linear notation of cipher systems. The attempt was concerned with two problems: (1) what are the rules of these systems and how can they be precisely formulated; (2) how can we evaluate the claims for uniqueness, completeness, etc. The second question led directly to two others: (1) how can the concepts of completeness, uniqueness and ambiguity be given precise mathematical meaning; (2) can the rules be written in such a form that these claims can be mathematically evaluated. This paper addresses itself to a more general consideration: the value of formal and mathematical methods for empirical sciences. The definitions and results of this paper are not merely the starting points and end products of a mathematical game, but are intended to delineate some of the significant properties of cipher systems. Author (USGRDR)

N69-16666*# Southern Methodist Univ., Dallas Tex.
[EFFICIENT ESTIMATION OF DISTRIBUTION FOR EXTREME OBSERVATIONS IN SAMPLE AND NONSAMPLE CASES] Progress Report, Period Ending 31 Dec. 1968]
John E. Walsh 31 Dec. 1968 11 p refs
(Grant NGR-44-007-028)
(NASA-CR-99266) Avail: CFSTI CSCL 12A

As a result of this research, many useful results were obtained for order statistics of sets of univariate observations. Both sample and nonsample cases were considered. Some results were for large sets (asymptotic case) but many are also applicable for small sets. An extension of asymptotic distributions for extremes of samples was considered. Conditions were developed for approximate independence of some order statistics, and the generality of the possible distributions for order statistics, and relations between sample and nonsample cases, were investigated. Some results were also obtained for a generalized form of median regression that uses order statistics. A technical outline of the work, and its extension of previous results, is given. A discussion of the usefulness of extreme-value theory is presented, along with a few conclusions related to the research. Author

N69-16668# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND THE SIMPLEST PROBLEM IN THE CALCULUS OF VARIATIONS
R. Kalaba and R. Sridhar Nov. 1968 18 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-678868; RM-5781-PR) Avail: CFSTI CSCL 12/1

The report gives a new method for transforming a minimization problem directly into an initial-value Cauchy problem, readily solved by analog or digital computers. It is based on a new conceptual approach to the calculus of variations that does not use Euler equations, the fundamental lemma, Bellmans optimality principle, or Pontryagin's maximum principle. The task is to minimize an integral subject to a single constraint. The method is based on the disappearance of the first variation. Author (TAB)

N69-16675 Syracuse Univ., N. Y.
ON DIRECT SUMS OF CYCLIC GROUPS
Geraldine Claudette Darden (Ph.D. Thesis) 1967 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-7769

The objective here has been to investigate Abelian groups which may be written as direct sums of cyclic groups. Of special interest are the necessary and sufficient conditions for doing this. Chapter I contains the necessary fundamental definitions and other facts which are used later in the paper. The concept of discrete direct sums of cyclic groups is presented in Chapter II. Some of the properties of complete direct sums of cyclic p-groups and infinite cyclic groups can be found in Chapter III. Important and useful results about torsion and torsion-free direct summands of

direct sums of p-groups appear here. Some of those groups whose duals are free Abelian are also mentioned. Some of the topological aspects of direct sums of cyclic groups are presented in Chapter IV. The last chapter seeks to summarize the other four by reviewing the most important results. Dissert. Abstr.

N69-16680 Michigan Univ., Ann Arbor.
SINGER GROUPS
Marshall Didrik Hestenes (Ph.D. Thesis) 1967 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 66-7627

The purpose of this thesis is to make a systematic study of the Singer subgroups of the linear groups, with a particular view to analyzing the examples they provide of a class of permutation groups generalizing the Zassenhaus groups. In chapter two we determine in just what cases a Singer group has the appropriate properties so that the representation satisfies Higman's conditions. Chapter three is devoted to the investigation of this representation in detail in some of the cases and of the rather interesting arithmetic which arises. In chapter four we determine all the cyclic self-centralizing T.I. sets in $PSL_n(q)$ in order to show that Singer groups are essentially the only cyclic T.I. sets in $PSL_n(q)$ yielding Higman's type of representation. Then, in chapter five we investigate the intersection of Singer groups with some of the other classical groups, and in particular we show that if we represent a unitary group on the cosets modulo the normalizer of the intersection of the unitary group and a Singer group, we get another infinite family of representations of this type. Dissert. Abstr.

N69-16724 Arizona Univ., Tucson
SOME PROBLEMS IN THE THEORY OF APPROXIMATION
Jimmie Baker Smith (Ph.D. Thesis) 1968 42 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-8311

In this paper two problems in approximation theory are considered. In the first part of this paper it is proved that if $\{f_k\} \in L_p[0,1]$ converges to f in L_p norm and if Φ_k is the best L_p approximation to f_k (over polynomials of degree N) and Φ is the best L_p approximation to f (over polynomials of degree N) then Φ_k converges uniformly to Φ. This result is used to come arbitrarily close to the best L_2 approximant to a given $f \in L_2[0,1]$ in such a manner that numerical integration is not required. In the second part of this paper Hermite–Fejér polynomials are used to approximate a given function continuous on $x \in [-1,1]$. This approximation is integrated to provide a quadrature rule for estimation of $\int_{-1}^{1} f(x)\,dx$. This estimate is extended to functions of several variables and bounds are obtained for the error of the estimate. Dissert. Abstr.

N69-16725 Oklahoma Univ., Norman.
FIXED POINT THEOREMS FOR SPACES REPRESENTED BY PARTIALLY ORDERED SYSTEMS
Raymond Joseph Gazik (Ph.D. Thesis) 1968 59 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-9037

The main aim of this work is to obtain fixed point theorems for spaces which are, in some sense, "represented" as partially ordered systems. For example, the metric representation of R. E. DeMarr is generalized to include Hausdorff uniform spaces, and a generalization of the classical contraction map theorem results. Again, it is shown that a complete lattice which is hausdorff and connected in its interval topology and has a continuous partial order is a fixed point space with respect to continuous multi-valued functions. Some pseudo fixed point theory is developed for topological unions of such lattices which possess a globally continuous class of functions. The problem of classifying those lattices for which a topology can be found which induces c and only c convergence, for a prescribed lattice convergence c, is unsolved. A partial solution to this problem is given by using convergence schemes. Dissert. Abstr.

N69-16727# Wisconsin Univ., Madison. Mathematics Research Center.
CONSTRUCTION OF β CONTENT TOLERANCE REGIONS AT CONFIDENCE LEVEL γ FOR LARGE SAMPLES FROM THE k-VARIATE NORMAL DISTRIBUTION Technical Summary Report
Irwin Guttman May 1968 42 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-679151; MRC-TSR-884) Avail: CFSTI CSCL 12/1

A method for construction of beta-content tolerance regions at confidence level gamma is developed, when sampling from the k-variate normal, and tables supplied. Certain efficiency considerations are discussed with respect to beta-content non-parametric regions and beta-content normal regions, and here also tables are supplied. The method assumes that sample sizes are large. Author (TAB)

N69-16747 Michigan State Univ., East Lansing.
APPROXIMATION OF VECTOR-VALUES FUNCTIONS
Lee Warren Johnson (Ph.D. Thesis) 1967 47 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-7908

Some of the properties of the extreme points of best approximations are examined, and several auxiliary notions, such as a generalization of H-sets are defined. Several characterizations of best approximations are given in terms of these auxiliary notions, and in terms of extreme points. Some applications and examples are given, including new proofs of several well-known theorems, cast in the form of vector-valued approximations. It is shown, for example, how a theorem of Moursund can be treated as a problem in approximation of vector-valued functions. Dissert. Abstr.

N69-16748 Illinois Univ., Urbana
MULTIPLICITIES AND GROTHENDIECK GROUPS
Marshall Monteith Fraser (Ph.D. Thesis) 1967 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-8079

The theory of multiplicities is treated here in the setting of Grothendieck groups. Let R be a commutative Noetherian ring and let I be an ideal in R generated by s elements. Then a multiplicity map is defined which is a homomorphism from the Grothendieck group of the category of finitely generated R-modules to the Grothendieck group of the category of finitely generated modules over R/I. The problem is posed of generalizing known properties of multiplicities to this map defined on Grothendieck groups. The Localization Principle, the Associative Law, and the Extension Formula all find generalizations and, drawing upon general properties of Grothendieck groups, the proofs are simplified. A new result concerns the calculation of the kernel of the multiplicity map. The Hilbert function is also defined, again with the generalization that it takes values in the Grothendieck group of the category of finitely generated modules over R/I. It is proven that, for sufficiently large integers n, the Hilbert function is a polynomial with coefficients in the Grothendieck group and degree at most s. The properties of this polynomial are discussed and the relation between it and the multiplicity map is explored. Dissert. Abstr.

N69-16755# Wisconsin Univ., Madison. Mathematics Research Center.
ON BEST APPROXIMATION BY INTERPOLATING POLYNOMIALS Technical Summary Report

L. L. Schumaker and G. D. Taylor Jan. 1968 12 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-678965; MRC-TSR-843) Avail: CFSTI CSCL 12/1

The problem of approximating a continuous function (with respect to a generalized weight function) by polynomials interpolating prescribed data is considered. Existence, uniqueness, and a computational algorithm are obtained. Author (TAB)

N69-16756# Wisconsin Univ., Madison. Mathematics Research Center.
ON SINGULAR PERTURBATION PROBLEMS WITH INTERIOR NONUNIFORMITIES
R. E. O'Malley, Jr. Apr. 1968 21 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-678974; MRC-TSR-864) Avail: CFSTI CSCL 12/1

Certain boundary value problems of the form epsilon y double prime = f(x,y,y',epsilon), 0 = or < x = or < 1; y(0) = alpha(epsilon), y(1) = beta(epsilon) have solutions whose derivatives exhibit nonuniform convergence within (0,1) as epsilon approaches 0+. A method for constructing asymptotic solutions to such problems is presented. The work is related to previous investigations by Haber and Levinson and Vasil'eva. Author (TAB)

N69-16760# Michigan Univ., Ann Arbor. Dept. of Industrial Engineering.
PRINCIPAL PIVOTING IN SYMMETRIC MATRICES WITH APPLICATION TO QUADRATIC PROGRAMMING
Edward L. Keller 1968 27 p refs
(Contract DA-ARO(D)-31-124-767)
(AD-678823; TR-1968-3) Avail: CFSTI CSCL 12/2

The paper discusses the following problem: Find vectors w and z such that (1) w sub T = q + Mz; (2) wz = 0; (3) w, z = or > 0 where M is an nxn matrix and q is an n-vector. Such problems have received extensive treatment in the case where M is positive semi-definite. We shall show here that certain simplifications are possible if, in addition, we assume that M can be obtained from a symmetric matrix by principal pivots. Author (TAB)

N69-16784 Princeton Univ., N. J.
STABILITY OF DISTRIBUTED SYSTEMS USING LIAPUNOV'S DIRECT METHOD
Albert Jeffrey Berger (Ph.D. Thesis) 1967 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-8906

This thesis concerns itself with the determination of the stability of the steady states of distributed systems. Stability is determined with respect to perturbations in the state of the system. Those systems which can exhibit multiple steady states are of interest. The keystone of this study is Liapunov's direct method. This method supplies a sufficient condition for stability without having to integrate the system's transient equations. It is shown that Liapunov's direct method can easily predict the stability of a system described by partial differential equations. Two distributed systems, the catalyst particle modeled as a slab, and the adiabatic tubular reactor with axial diffusion are discussed in detail. Stability with respect to two different types of perturbations is analyzed. Dissert. Abstr.

N69-16775# Wisconsin Univ., Madison. Mathematics Research Center.
SOME INTEGRABILITY THEOREMS FOR POWER SERIES WITH POSITIVE COEFFICIENTS Technical Summary Report
R. Askey and R. P. Boas, Jr. Feb. 1968 16 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-678967; MRC-TSR-850) Avail: CFSTI CSCL 12/1

The L superscript p integrability of power series with positive coefficients is connected with averages of the coefficients for o < p = or < infinity. Author (TAB)

N69-16776# Wisconsin Univ., Madison. Mathematics Research Center.
A BILINEAR GAME WITH THE SPACE OF ONE PLAYER UNBOUNDED Technical Summary Report
John M. Danskin Feb. 1968 11 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-678968; MRC-TSR-855) Avail: CFSTI CSCL 12/2

The bilinear game M(u,v), with u in a polyhedron defined by finitely many planes and v in a compact polyhedron defined by finitely many planes, has a solution if there is a v for which M(u,v) is bounded above. Author (TAB)

N69-16777# Wisconsin Univ., Madison. Mathematics Research Center.
MULTIPLIERS OF AN ANNIHILATOR ALGEBRA Technical Summary Report
Wai-Mee Ching and James S. W. Wong Jun. 1968 9 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-678970; MRC-TSR-870) Avail: CFSTI CSCL 12/1

Let A be a semi-simple annihilator Banach algebra, and E be the space of all minimal closed two-sided ideals in A. Denote by M(A) the set of all bounded linear operators T satisfying (Tx)y = x(Ty) for all x, y epsilon A. The main result proved in this note is the following theorem: There exists a norm-decreasing isomorphism of M(A) onto C superscript infinity symbol (E), the space of all bounded continuous complex functions on E. Author (TAB)

N69-16797# Wisconsin Univ., Madison. Mathematics Research Center.
NUMERICAL TREATMENT OF BIHARMONIC BOUNDARY VALUE PROBLEMS WITH RE-ENTRANT BOUNDARIES
M. J. M. Bernal and J. R. Whiteman Jul. 1968 26 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-678973; MRC-TSR-914) Avail: CFSTI CSCL 12/1

The failure of the standard finite-difference techniques produce an accurate approximation to the exact solution of a biharmonic boundary value problem for which the region of definition contains a re-entrant corner is considered. Variants of the methods proposed by Motz and Woods for solving a similar type of harmonic problem are applied to a particular biharmonic problem of this class. Author (TAB)

N69-16799# Harry Diamond Labs., Washington, D. C.
RADIX METHOD OF CALCULATING NATURAL LOGARITHMS IN BINARY NOTATION
Herbert Dropkin Oct. 1968 21 p
(AD-679018; HDL-TR-1393) Avail: Issuing Activity CSCL 12/1

The report describes a radix method of calculating the natural logarithm of a number when both the number and the logarithm are in binary form. The method requires no multiplications or divisions and is suitable for high accuracy. Certain key values required have been calculated and are tabulated. Author (TAB)

N69-16808# Wisconsin Univ., Madison. Mathematics Research Center.

INADMISSIBILITY OF THE BEST INVARIANT TEST WHEN THE MOMENT IS INFINITE UNDER ONE OF THE HYPOTHESES

Martin Fox and S. K. Perng Apr. 1968 11 p refs

(Contracts DA-31-124-ARO(D)-462; Nonr-2587(02))

(AD-678972; MRC-TSR-873) Avail: CFSTI CSCL 12/1

Let X and Y be real valued random variables with joint density g sub i (y) f sub i (x-theta, y) under the hypothesis H sub i (i = 1, 2). Assume theta is unknown. The best invariant test of H sub 1 vs H sub 2 is known to be admissible if X has a finite first moment under both hypotheses. The present paper provides an example in which admissibility fails if under one hypothesis the first moment is infinite. Author (TAB)

N69-16809# Wisconsin Univ., Madison. Mathematics Research Center.

NUMERICAL SOLUTION OF A HARMONIC MIXED BOUNDARY VALUE PROBLEM BY LINEAR PROGRAMMING

J. R. Whiteman Mar. 1968 15 p refs

(Contract DA-31-124-ARO(D)-462)

(AD-678969; MRC-TSR-857) Avail: CFSTI CSCL 12/1

A method using the linear programming algorithm is given for obtaining a numerical solution with an error bound to a harmonic mixed boundary value problem in which the region of definition is a rectangle containing a slit. Author (TAB)

N69-16811*# Illinois Univ., Urbana. Biological Computer Lab.

CRITICAL DEGENERATENESS IN LARGE LINEAR SYSTEMS

Mark R. Gardner 15 Jun. 1968 61 p refs

(Grant NGR-14-005-111; Contract AF-33(615)-3890; Grant AF-AFOSR-7-67)

(NASA-CR-73651; BCL-5.8) Avail: CFSTI CSCL 12A

A class of linear systems, composed of intrinsically stable elements, was studied. These linear systems were represented by the coefficient matrices of their differential equations. A sample space of these matrices was defined by specifying the nature of the distributions from which the matrix entries were selected. Matrices of given size were generated by random sampling from the defined sample space. Appropriate weighting of the distributions gave control of the degenerateness, a measure of the number of zero entries. The Hurwitz criterion was used to test whether each matrix represented a stable system. The primary goal was to find the probability of stability as a function of degenerateness. It was found, even for the relatively small matrices within the range of this study, that the degenerateness is critical. For values of degenerateness less than a particular amount (about 85%), the system is almost certainly unstable, whereas for values of degenerateness greater than this amount, the system is almost certainly stable. Author

N69-16819# Wisconsin Univ., Madison. Mathematics Research Center.

ON THE ASYMPTOTIC SOLUTION OF BOUNDARY VALUE PROBLEMS FOR NONHOMOGENEOUS ORDINARY DIFFERENTIAL EQUATIONS CONTAINING A PARAMETER

Technical Summary Report

R. E. O'Malley, Jr. May 1968 23 p refs

(Contract DA-31-124-ARO(D)-462)

(AD-678971; MRC-TSR-872) Avail: CFSTI CSCL 12/1

Complete asymptotic solutions are obtained for certain boundary value problems for nonhomogeneous linear ordinary differential equations containing a small parameter. Author (TAB)

N69-16849# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.

NORM MINIMIZATION ON NONLINEAR MANIFOLDS IN HILBERT SPACE

Frederick C. Johnson Oct. 1968 15 p refs *Its* Inform. Sci. Rept. No. 22

(AD-678976; D1-82-0758) Avail: CFSTI CSCL 12/1

A problem in estimation theory that frequently arises in aerospace technology is the determination of a best estimate of a set of parameters x given a sequence of noisy measurements y sub 1, y sub 2,...,y sub n and the fact that, in the absence of noise, a nonlinear equation of the form f(x,y sub i) = 0 is satisfied. The solution to this nonlinear estimation problem is dependent upon finding a computational method for minimizing norm z subject to a nonlinear constraint g(z) = 0. This paper considers the problem of minimizing norm z on the manifold M = (z: g(z) = 0), where g is a suitably differentiable function mapping the Hilbert space E into the Hilbert space F. A method is given for generating a sequence of points (in braces: z sub k) in E such that g(z sub k) converges to zero and which, under suitable additional assumptions, converges to an element in M of minimum norm. Author (TAB)

N69-16865 Illinois Univ., Urbana.

LINEAR ALGEBRA OVER SKEWFIELDS

Paul Robert Wilson (Ph.D. Thesis) 1967 68 p

Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-8271

Standard concepts and theorems of linear algebra are generalized to the case of vector spaces over skewfields. In particular it is shown that every linear transformation has a reduced characteristic polynomial, relative to which the Dieudonné determinant serves the same purposes as ordinary determinants do to characteristic polynomials in the classical case. The Cayley–Hamilton theorem, characteristic values, structure theorems for diagonalizable operators, and canonical forms are discussed. Most of the basic results of linear algebra are satisfactorily generalized. Dissert. Abstr.

N69-16873# Research Analysis Corp. McLean, Va.

ASYMPTOTIC CONDITIONS FOR CONSTRAINED MINIMIZATION

Anthony V. Fiacco and Garth P. McCormick Nov. 1968 40 p refs

(Contract DA-44-188-ARO-1)

(AD-679039; RAC-TP-340) Avail: CFSTI CSCL 12/2

The characterization of a local solution of a constrained minimization problem has traditionally been given in terms of the problem functions and the associated Lagrangian evaluated at the solution point for a corresponding set of finite Lagrange multipliers. A recent exception is given by Kortanek and Evans who give a characterization of optimality in terms of limiting properties of the problem functions and associated Lagrangian, taken over an appropriate sequence of points and multipliers. This characterization is significantly generalized, and very general necessary and sufficient asymptotic conditions under various assumptions are obtained. These results enlarge the class of problems for which optimality criteria can be given. In particular, several well-known sets of 'finite multiplier' necessary conditions are implied as special cases, and first- and second-order results such as those obtained by Fitz John, L. Pennisi, and others are extended. Author (TAB)

N69-16879# Wisconsin Univ., Madison. Mathematics Research Center.

ON ERGODIC QUASI-INVARIANT MEASURES ON THE CIRCLE GROUP

V. Mandrekar and M. Nadkarni Feb. 1968 16 p refs
(Contracts DA-31-124-ARO(D)-462; N00014-67-c-0307)
(AD-678966; MRC-TSR-846) Avail: CFSTI CSCL 12/1

The paper studies the structure of measures on a circle, quasi-invariant and ergodic under translation by a dense subgroup.
Author (TAB)

N69-16902# RAND Corp., Santa Monica, Calif.
INVERTIBLY POSITIVE LINEAR OPERATORS ON SPACES OF CONTINUOUS FUNCTIONS
T. A. Brown, M. L. Juncosa, and V. L. Klee Oct. 1968 27 p refs
(Contract F44620-67-C-0045)
(AD-678865; RM-5374-PR) Avail: CFSTI CSCL 12/1

A proof is given that any positive linear transformation of a space of continuous functions with a positive inverse has a certain specific form. The characterization is the same as that found by Kaplansky and others, but here it is obtained under weaker assumptions as to the topological space X and the linear space F of real-valued functions. The study was motivated by a problem in logistics, which, mathematically, was to find conditions necessary and sufficient for a positive matrix to have one of its powers equal to the identity matrix.
Author (TAB)

N69-16956*# Midwest Research Inst., Kansas City, Mo.
DIFFERENTIAL-DIFFERENCE PROPERTIES OF GENERALIZED JACOBI POLYNOMIALS Interim Report
Jet Wimp 15 Jan. 1969 10 p refs
(Contract NAS9-7641)
(NASA-CR-92470) Avail: CFSTI CSCL 12A

In this paper we derive a differential-difference equation satisfied by hypergeometric polynomials.
Author

N69-16958# RAND Corp., Santa Monica, Calif.
ACCELERATING LP ALGORITHMS
B. L. Fox Nov. 1968 6 p refs
(AD-678502; P-3861) Avail: CFSTI CSCL 12/2

Winograd has given a new method for computing inner products. Under certain circumstances, when a series of inner products must be calculated, using Winograds scheme is more efficient than the standard (naive) method. Winograd points out that his method does matrix multiplication up to twice as fast as the usual scheme and notes similar acceleration for matrix inversion and the solution of linear equations. This report describes how Winograds method can speed up linear programming algorithms, in particular the revised simplex method.
Author (TAB)

N69-16967 Michigan Univ., Ann Arbor.
SOME EXTREMAL PROBLEMS IN THE THEORY OF ANALYTIC FUNCTIONS
Mangalam Ramaswamy Gopal (Ph.D. Thesis) 1967 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-7613

Extensions and generalizations of certain results concerning estimates for the radius of starlikeness, convexity and close-to-convexity of some classes of analytic functions in the unit disk are treated. Rotation theorems for starlike and close-to-convex functions are also analyzed. A study of the coefficients of functions with bounded boundary rotation is included.
Dissert. Abstr.

N69-16976# Joint Publications Research Service, Washington, D. C.
CYBERNETICS AND REGULATION THEORY
16 Dec. 1968 36 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 182, nos. 2, 3, 4, and 5, 1968
(JPRS-47089) Avail: CFSTI

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2. THEORY OF ADAPTIVE SYSTEMS V. A. Yakubovich p 6–12 refs (See N69-16978 06-19)

3. AUTOMATON MAPPING AND FUNCTIONAL SEMIMATRICES FOR A SYMMETRICAL SEMIGROUP OF THE ALPHABET V. P. Zarovnyy p 13–19 refs (See N69-16979 06-19)

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5. PARTIAL STABILITY OF PROBABILITY AUTOMATA B. S. Kochkarev p 27–33 refs (See N69-16981 06-19)

N69-16978# Joint Publications Research Service, Washington, D. C.
THEORY OF ADAPTIVE SYSTEMS
V. A. Yakubovich *In its* Cybernetics and Regulation Theory 16 Dec. 1968 p 6–12 refs (See N69-16976 06-19)
Avail: CFSTI

An exact formalized statement of the simplest version of the problem of building a system according to a given class, and reasonable in this class (e.g., the simplest robot) is presented in the form of two theorems. The problem is solved under a number of assumptions, and the results are illustrated by two mathematically stylized examples of simplest systems which are reasonable in the indicated, highly conditional, sense.
Author

N69-16979# Joint Publications Research Service, Washington, D. C.
AUTOMATION MAPPING AND FUNCTIONAL SEMIMATRICS FOR A SYMMETRICAL SEMIGROUP OF THE ALPHABET
V. P. Zarovnyy *In its* Cybernetics and Regulation Theory 16 Dec. 1968 p 13–19 refs (See N69-16976 06-19)
Avail: CFSTI

Propositions are formulated for deriving two theorems for a set of automaton mappings given by specified functional semimatrices for a symmetrical semigroup of the alphabet. Specifically, the set of all possible functions $\alpha(x)$ given in a fixed finite alphabet X of $n \geq 2$ elements, with values in its symmetrical semigroup $S^*(X)$ is considered.
A.C.R.

N69-16980# Joint Publications Research Service, Washington, D. C.
AUTOMATON MAPPING AND MATRICES FOR A SYMMETRICAL SEMIGROUP OF AN ABELIAN GROUP
V. P. Zarovnyy *In its* Cybernetics and Regulation Theory 16 Dec. 1968 p 20–26 refs (See N69-16976 06-19)
Avail: CFSTI

The results of investigating automaton mappings that permit matrix representations of a symmetrical semigroup of the alphabet are discussed. The structure of the additive semigroup with zero and the structure of the abelian group are defined. A special case is presented made up of mappings which may be represented by matrices for a ring with unity or a near field defined in the alphabet, including linear automaton mappings over a commutative ring with unity.
Author

N69-16981# Joint Publications Research Service, Washington, D. C.
PARTIAL STABILITY OF PROBABILITY AUTOMATA

B. S. Kochkarov *In its* Cybernetics and Regulation Theory 16 Dec. 1968 p 27–33 refs (See N69-16981 06-19)
Avail: CFSTI

The question has arisen in probability automaton (p.a.) theory as to whether or not the behavior of the probability automaton is stable (invariant) for small disturbances of the intermediate probabilities. The probability automaton stability theorem of M. O. Rabin was extended to the general class of probability automata in this discussion. It was found that this class of p.a. with isolated points of intersection represent deficit events, making possibilities of p.a. for isolated intersection points no higher than for real p.a. The question as to whether or not at least part of the behavior of probability automata can be stable, and if so, which part, is also treated. Author

N69-16995# Army Biological Labs., Fort Detrick, Md.
ON SOME COUPLED INTEGRAL EQUATIONS [O NEKOTORYKH SPARENNYKH INTEGRALNYKH URAVENII]
N. I. Akhiezer Jul. 1968 7 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 98, no. 3, 1954 p 333–336
(AD-678901; TRANS-568) Avail: CFSTI CSCL 12/1

The author discusses solution techniques for pairs of coupled integral equations. TAB

N69-17001# Columbia Univ., New York. Electronics Research Labs.
ON DISTRIBUTIONS ASSOCIATED WITH THE MULTIDIMENSIONAL NORMAL DISTRIBUTION Final Report
Kenneth S. Miller Jun. 1968 7 p
(Contract DA-31-124-ARO(D)-255)
(AD-679138; CUERL-F/314; AROD-5132-8-RT) Avail: CFSTI CSCL 12/1

This is the final report on a project directed to the study of the problem of constructing distributions associated with n independent Gaussian processes. Papers resulting from these efforts, personnel who participated in the project, and activities connected with the research are cited. Author (TAB)

N69-17056# Michigan Univ., Ann Arbor.
SOME SYSTEM SENSITIVITY PROBLEMS Final Report, May 1965–Sep. 1968
William A. Porter 1 Sep. 1968 7 p refs
(Contract DA-31-124-ARO(D)-391)
(AD-679194; Rept-7396-1-L) Avail: CFSTI CSCL 12/1

The contract provided support for basic research in the area of system science. More specifically, problems of system sensitivity, system optimization, and system structure were considered, with the major emphasis on system sensitivity. A unifying feature of the program was the use of function spaces as the vehicle for analysis. Author (TAB)

N69-17060# Wisconsin Univ., Madison. Dept. of Statistics.
BAYESIAN ESTIMATION OF LATENT ROOTS AND VECTORS, WITH SPECIAL REFERENCE TO BIVARIATE NORMAL DISTRIBUTION Final Technical Report, Sep. 1967–Apr. 1968
George C. Tiao and Stephen Fienberg (Harvard Univ.) May 1968 28 p refs
(Grants DA-ARO(D)-31-124-G817; NSF GP-6519)
(AD-679203; TR-159) Avail: CFSTI CSCL 12/1

The paper discusses some aspects of the estimation of latent roots and vectors of the covariance matrix of the bivariate normal distribution from a Bayesian viewpoint. The joint distribution of (1) the angle of the canonical transformation and (2) the ratio of the larger root to the total variance is considered in detail and illustrated by an example. Also discussed is the problem of making inferences about the larger roots, and several simple approximations to its distribution are considered. Finally a generalization of one of the approximation methods to latent roots of higher dimensional convariance matrix is given. Author (TAB)

N69-17065# Applied Logic Corp., Princeton, N. J.
CRT-AIDED SEMI-AUTOMATED MATHEMATICS Final Report, 1 Oct. 1966–31 May 1968
James H. Bennett, James R. Guard, Roger Haydock, Francis C. Oglesby, William L. Paschke et al Jul. 1968 41 p refs
(Contract F19628-67-C-0100; ARPA Order 700)
(AD-678578) Avail: CFSTI CSCL 12/1

The report describes the status of the sixth in a series of six experiments in semi-automated mathematics. This effort extended from 1 October 1966 through 31 May 1968. These experiments culminated in large complex computer programs which allow a mathematician to prove mathematical theorems on a man-machine basis. SAM VI, the sixth program, uses a cathode ray tube as the principal interface between the mathematician and a high speed digital computer. An elaborate language and logical capability has been implemented in SAM VI. These include I/O languages for expressing mathematical statements in a form suitable for both the mathematician and the machine to recognize and handle with ease and convenience, a language for expressing and handling sorts and range of symbols, and auto-logic algorithm and matching routine. The latter constitute the capability for handling, automatically, logic with equality. This capability is particularly useful at an intermediate state of the proof when it is desired to have the machine try to verify automatically a given portion of the proof. Author (TAB)

N69-17072 National Lending Library for Science and Technology, Boston Spa (England).
THE SOLUTION OF ONE CLASS OF MATHEMATICAL PROGRAMMING PROBLEMS ON ANALOGUE COMPUTERS [RESHENIE ODNOGO KLASSA ZADACH MATEMATICHESKOGO PROGRAMMIROVANIA NA ANALOGOVYKH VYCHISLITEL'NYKH MASHINAKH]
E. E. Dudnikov and M. V. Rybashov 21 Jan. 1969 10 p refs Transl. into ENGLISH from Vopr. Teorii i Primenenya Matemat. Model (USSR), 1965 p 166–175
(NLL-RTS-4846) Avail: Natl. Lending Library, Boston Spa, Engl.: 25s

A method is proposed for the solution by an analogue computer of nonlinear programming problems of one particular class. The method is not connected with the use of the properties of convex programming as assumed by the Pyne method, and, within the limits of problems of this class, permits the solution of problems of nonconvex programming. Author

N69-17083# Joint Publications Research Service, Washington, D. C.
DISCOVERY OF THE MULTIPLICITY OF MATHEMATICS AND ITS PHILOSOPHICAL SIGNIFICANCE
Ernest Kohlman *In its* Phil. Probl. of Forecasting and Organizing USSR Sci. 10 Jan. 1969 p 51–56 refs (See N69-17079 06-34)
Avail: CFSTI

Examples are given to show that philosophers of various schools borrowed argumentation from mathematics; this is especially true of philosophers of the idealistic schools owing to the extremely abstract nature of mathematics. Some mathematical concepts are briefly explained, such as the set theory, Cantor's antinomy, Russel's antinomy, potential infinity, actual infinity, intuitionism, logicism, conventionalism, and ultraconstructivism. M.G.J.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N69-16214*# Texas Western Coll., El Paso. Shellenger Research Labs.
EXAMETNET DATA REPORT SERIES Annual Report, 1966
Washington NASA 1968 190 p Sponsored by NASA, Comision Nacl. de Invest. Espacial., and Comissao Nacl. de Atividades Espaciais
(NASA-SP-175) Avail: CFSTI CSCL 04B

This annual publication contains, for the year 1966, the meteorological rocket observational wind and temperature data acquired by each participant of the network. Appendixes concerning related activities of the EXAMETNET are also included in the annual reports. The appendix for this report contains the special 1965 firing series from Wallops Island, Virginia, for the months of September through November. Author

N69-16217# American Meteorological Society, Boston, Mass.
SOME PROBLEMS IN THE THEORY OF THE FORMATION OF CLOUDS AND PRECIPITATION
N. S. Shishkin. Bedford, Mass. AFCRL Sep. 1968 16 p refs Transl. into ENGLISH from Tr. Vses. Nauchn. Meteorol. Soveshch (USSR), v. 5, 1963 p 3-9
(AD-678529; AFCRL-68-0461; AFCRL-Trans-18) Avail: CFSTI CSCL 4/2

Research on clouds and precipitation has undergone considerable development in the Soviet Union during the last forty years. In the pre-war years, a great deal of data was collected from the network of weather stations on clouds and precipitation; synoptic methods of forecasting these phenomena were developed; a substantial amount of laboratory research was carried out on thunderstorm electricity and the mechanism of precipitation formation; and research was begun on clouds in the vicinity of mountains. Immediately after the war, research was renewed in the Soviet Union on the active modification of clouds and fog. Physical methods have been developed for forecasting cloudiness and precipitation, based on the solution to dynamic atmosphere equations and energy relationships. In recent years, more and more effort has been put into cloud research and into the development of methods of active modification. Author (TAB)

N69-16273# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF VARIABILITY OF A CORIOLIS FORCE ON CHANGE IN GEOPOTENTIAL FIELD IN THE PRESENCE OF MOUNTAINS
Z. V. Khvedelidze 6 Nov. 1967 13 p refs Transl. into ENGLISH from Soobshch. Akad. Nauk Gruzin. SSR (Tiflis), v. 27, no. 2, 1961 p 143-150
(AD-678773; FTD-HT-23-1377-67) Avail: CFSTI CSCL 4/2

The dependence of the Coriolis force on latitude is not taken into account in studies relating to short-range forecasting of the geopotential field for mountainous areas. The purpose of this paper is to present a theoretical analysis of this dependence for a case of predication at the mean level. The methods of operational calculus are used to solve the principal equation of the geopotential problem with given initial conditions. The necessary computations were made on the Strela electronic computer for data pertaining to the Caucasus Mountains, (oriented along the parallel), and for the Rocky Mountains (oriented along the meridian). The forecast was prepared at 0300, 1206, and 2400 hours. It was found that the influence of mountains and the influence of the variability of Coriolis force on the change of the geopotential field increases with time. The influence of mountains oriented along the meridian is greater than that of mountains oriented along the parallel. TAB

N69-16317# Analysis and Computer Systems, Inc., Burlington, Mass.
DESIGN OF A DIGITAL SIMULATION OF THE POLAR PLANIMETER FOR CALCULATING AREAS OF ECHOES FROM RADAR WEATHER OBSERVATIONS Interim Report
Ronald G. Kelley Jun. 1968 74 p
(Contract F19628-67-C-0126)
(AD-678553; AFCRL-68-0341; SR-2) Avail: CFSTI CSCL 4/2

The effort discussed in the report was to fulfill a requirement for expediently analyzing data on radar weather prediction techniques. Data is recorded at various radar stations, which make hourly weather observations on the local weather activity within a range of 200 miles. The observers record polar coordinate data that represents the echoes for that hour. Other parameters such as density, trend, tendency and height, are also recorded to provide a snapshot of the weather situation. Discussed herein is the design of the computer program RADNDX for (1) plotting a set of hourly snapshots of the radar screen, and (2) calculating an hourly Radar Index (RI), which is the sum of the weighted echoes within a range of 50 miles of the station, divided by the area of the 50-mile circle. The program sorts the data into hourly batches, converts it into cartesian coordinates, and plots and labels all pertinent data to provide the hourly snapshots. Surveying techniques are applied through some specialized trigonometry to extract the area of those portions of the echoes within a given range of the station. Each area is weighted, and the sum is converted to an RI. The program checks all data for discrepancies, monitors itself to check for errors, and generates a list of pertinent information for further analysis. Author (TAB)

N69-16403 Chicago Univ., Ill. Dept. of Geophysical Sciences.
WEATHER RADAR FOR THE SUPERSONIC TRANSPORT
David Atlas 30 Sep. 1968 16 p refs Presented at Air Transport Assoc., Meteorol. Comm., Chicago, 3 Oct. 1968 Supported in part by United Airlines Found.
(TN-3) Avail: Issuing Activity

The increased speed of the SST introduces many demands on both airborne and ground weather radars. These include increased range of detection and decreased decision-making times. The K-band radar is recommended for greater range on smaller particles, as is the use of Doppler techniques which allow for increased sensitivity by coherent integration. Improved data processing and display techniques are considered a must in order to decrease the decision-making time and increase the reliability of decisions. The K-band radar is also required for greatly improving resolution in finding safe passageways between adjacent storms, for storm top profiling, and for the detection of clouds and cloud-associated turbulence. Because of the excessive attenuation of 0.9 cm radiation by rain and dense water clouds, a complete system will have to be dual wavelength, probably at K- and C-bands. The relative attenuation at the two wavelengths can be exploited as an indication of large water densities, and thus of icing hazards and probable updrafts. Author

N69-16722# Northeastern Forest Experiment Station, Upper Darby, Pa.
A TREETOP TRAMWAY SYSTEM FOR METEOROLOGICAL STUDIES
Raymond E. Leonard and Arthur R. Eschner 1968 13 p
(FSRP-NE-92; PB-179552) Avail: CFSTI CSCL 13I

A system of tramways was built between several towers so that meteorological instruments could be passed above the

forest canopy to measure spatial variation in reflected short-wave radiation. The system has operated well under all weather conditions for over a year. Construction details for the tramway system are described. Author (USGRDR)

N69-16793# Gulton Industries, Inc., Albuquerque, N. Mex. Data Systems Div.
AFRPL MICRO-METEOROLOGICAL SYSTEM Final Report
Ronald J. Grosch Edwards AFB, Calif. AFRPL Nov. 1968 67 p refs
(Contract F04700-68-C-0336)
(AD-678856; AFRPL-TR-68-37) Avail: CFSTI CSCL 4/2

The Micromet System provides the Edwards Rocket Propulsion Laboratories meteorologist with a complete weather status of the entire area for use in making operational decisions. Sixty-four sensors are mounted on sixteen towers which are located to optimally cover the test range. The data from all the sensors is automatically gathered under computer control at the rate of two samples per second per sensor. The data is processed by the computer and out-putted in several different but complementary ways for use by the meteorologist. These include a pictorial display map, a data logger, typewritten messages and punched cards. One of the most useful messages is the solution of dispersion prediction equations relating to the dispersion probability of gas clouds resulting from the rocket motor test firings. The dispersion prediction calculations are quite involved, yet they are done routinely by the computer. It would be impossible to do them manually in the time available and further, the undesirable factor of human error is not present. Another feature of Micromet is an automatic computer controlled calibration system which calibrates the system once each 30 minutes. Data scaling factors are obtained from this which maintain the data accuracy. Also, maintenance messages result which are automatically typed out for any sensors that are out of tolerance by more than a predetermined amount. The system operates 24 hours a day, 365 days a year without an attendant except for scheduled maintenance periods. Author (TAB)

N69-16796# McGill Univ., Montreal (Quebec). Stormy Weather Group.
WEATHER RADAR STUDIES Final Report, 1 Jan. 1967-30 Jun. 1968
J.Stewart Marshall Jul. 1968 10 p refs
(Contract F19628-67-C-0129)
(AD-678886; AFCRL-68-0407) Avail: CFSTI CSCL 4/2

It appears from one large snowstorm that radar can be used to measure snowfall rates and amounts over areas up to 10 000 sq mi, perhaps 30 000 sq mi. For dry snow a wavelength of 3.2 cm can be used, but few situations yield reliably dry snow at all heights. In a large thunderstorm, proportionality was found between the mass of rain in the storm and the rate at which the rain was falling out. The rate of generation of rain rose almost exponentially, then changed to decay almost exponentially, and the observations were fitted closely by the relation P sub g = K C P, where P sub g is rate of generation of precipitation and C and P are masses of cloud and precipitation. Statistics of attenuation by rain on microwave links, either ground-to-ground or ground-to-satellite have been calculated from weather-radar data. It has been found, for example, that at 10 GHz, an attenuation of 30 db is exceeded (at low angles) for about 15 minutes per year, most likely on a single occasion, while 10 db is exceeded for five times as long, distributed over several occasions. Author (TAB)

N69-16806# White Sands Missile Range, N. Mex. Atmospheric Sciences Research Office.
ANALYSIS OF HIGH-FREQUENCY COMPONENTS OF AN/FPS-16 RADAR DATA
B. T. Miers and E. P. Avara Aug. 1968 56 p refs
(AD-679025; ECOM-5207) Avail: CFSTI CSCL 17/9

Simultaneous radar tracks of a meteorological target by AN/FPS-16 radars were used to investigate observed differences in position data. A linear digital filter was applied to the data to eliminate the low-frequency portion of the data record. Frequency-distribution histograms were computed for several parameters so that magnitudes of differences could be determined. The differences in position appear to be of a bias nature, and a significant number of them could be as much as 160 feet in the X direction, 120 feet in the Y direction, and 140 feet in the X direction. A significant spike in the slant range spectra occurred between 3 and 4 Hertz. Author (TAB)

N69-16847# Army Electronics Command, Fort Monmouth, N. J.
WINDCHILL NOMOGRAN, ENVIROMETER (FRIGORIMETER) T-W-P-R FACTOR AND HUMIDITY IN BOUNDARY-LAYER ARCTIC METEOROLOGY
Emily C. Taylor-Ellis Aug. 1968 19 p refs
(AD-678486; ECOM-3003) Avail: CFSTI CSCL 4/2

A windchill nomogram is presented as a short method of boundary-layer temperature versus wind-speed measurement. This nomogram correlates well, but it is not as definitive as the Envirometer (Frigorimeter) T-W-P-R* factor at simultaneous time-place data for personnel survival in difficult arctic polar environments. Analogous humidity and weather data also agree with the windchill nomogram. Author (TAB)

N69-16878# McGill Univ., Montreal (Quebec). Stormy Weather Group.
LIFE-CYCLE OF A SUMMER STORM FROM RADAR RECORDS
Clifford D. Holtz May 1968 60 p refs
(Contract F19628-67-C-0129)
(AD-678885; MW-55; AFCRL-68-8305; SR-6) Avail: CFSTI CSCL 4/2

Using radar, the area, the volume and the mass of precipitation in a thunderstorm have been studied as well as their distributions with intensity, height and time. A three-dimensional model, derived statistically, indicates that at each moment during the life-cycle the general spatial shape and intensity structure of the radar-observed storm is related to the total mass of precipitation aloft. Author (TAB)

N69-16932# Weather Squadron (28th) (MAC), New York 09127.
VISIBILITY IMPROVEMENT GRAPHS
Robert C. Sabin Oct. 1968 42 p
(AD-678932) Avail: CFSTI CSCL 4/2

This study blends pure climatology with subjective reasoning to produce a visibility improvement forecast. It presents a method of deriving visibility improvement graphs from persistence-probability tables prepared by the USAF Environmental Technical Applications Center (ETAC). In addition, a set of subjective rules for modifying the graphical forecast is developed. These rules are combined with the graphical forecast in a semi-objective visibility improvement checklist. Author (TAB)

N69-16938# Office of Naval Intelligence, Washington, D. C. Translation Div.
FORMATION OF THE WIND PROFILE IN THE BOUNDARY AIR LAYER OVER THE SEA SURFACE [FORMIROVANIYE PROFILYA VETRA V PRIZEMMON SLOE VOZDUKHA NAD POVERKHNOST'YU MORYA]
O. A. Kuznetsov 5 Sep. 1968 20 p refs Transl. into ENGLISH from Tr. Inst. Okeanol., Akad. Nauk SSSR (Moscow), v. 78, 1965 p 179-191
(AD-679320; NIC-Trans-2685) Avail: CFSTI CSCL 4/2

The paper gives an analysis of observational data obtained on the 35th voyage of the expeditionary vessel Vityaz in the Indian Ocean in 1962 and on a short expedition in the Black Sea in 1963. Author (TAB)

N69-16942# Office of Naval Intelligence, Washington, D. C. Translation Div.
LABORATORY UNDER THE CLOUDS [LABORATORIYA POD OBLAKAMI]
G. Sivoplyas 5 Sep. 1968 8 p Transl. into ENGLISH from Nauka i Tekhn. (Riga), no. 5, 1966 p 41–42
(AD-679354; NIC-Trans-2687) Avail: CFSTI CSCL 4/2

The flight of an aircraft laboratory makes it possible to conduct aerological observations at desired points in the atmosphere with direct participation by man. Aerologists aboard an aircraft can supplement instrument readings by visual observations of the lower and upper boundaries of cloud layers, density, and microstructure of clouds, visibility and icing. Reconnoitering the weather along the flight route they determine the location of thunderstorm centers, investigate the distribution of frontal cloud cover, and flight conditions in jet streams and in upper-level clouds. Author (TAB)

N69-17057*# Techtran Corp., Glen Burnie, Md.
WINTER CLOUD DISTRIBUTION OVER THE PACIFIC OCEAN ON THE BASIS OF AN ANALYSIS OF ATS PHOTOGRAPHS
Kiyoshi Tsuchiya et al Washington NASA Jan. 1969 13 p refs Transl. into ENGLISH from Tenki (Japan), v. 15, no. 5, May 1968 p 189–195
(Contract NASw-1695)
(NASA-TT-F-12026) Avail: CFSTI CSCL 04B

Analysis of Application Technology Satellite photographs covering the entire Pacific Ocean reveals the following characteristics in the wide scale distribution of cloud cover during the months of December and January: (1) There are few clouds along the equator east of 150°E., but large cloud bands, or cloud regions, on both sides of the equator extend to the east and west. (2) There are a large number of clouds in the highs, which center in the vicinity of 35°N. and 140°W., west of North America. (3) Few clouds exist below the axis of the high pressure belt in the medium latitudes in a 500 mb weather map. (4) The jet stream axis on the 200 mb surface is along the northern edge of the cloud band along the polar front. The cloud band which parallels the jet stream is narrow where the clouds are close-knit and wide where they are dispersed. (5) The line along which the relative vorticity at 500 mb is 0 nearly coincides with the line along the polar front. (6) A cloud band extends east and west to the east of 170°W. within the southern hemisphere. Author

N69-17078# Weather Squadron (15th), Detachment 10, McGuire AFB, N. J.
TERMINAL FORECAST REFERENCE FILE FOR McGUIRE AFB, NEW JERSEY
Thomas M. Heron 12 Jul. 1968 141 p refs Revised
(AD-678590) Avail: CFSTI CSCL 4/2

This report is an update and revision of an older report that was completed in 1961 and contains climatological data, climatic aids and local forecast studies for McGuire AFB, New Jersey. Author (TAB)

N69-17096 National Lending Library for Science and Technology, Boston Spa (England).
ON FORECASTING CONSIDERABLE SEPTEMBER AIR TEMPERATURE ANOMALIES IN THE EUROPEAN USSR
N. H. Zaharova [1968] 17 p refs Transl. into ENGLISH from Tr. Vyp. Gidromet. Nauk. Issled. Cent. SSSR (Leningrad), v. 23, 1968 p 21–30
(NLL-M-7453-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.

A continuation of an investigation of air temperature anomalies for European U.S.S.R. (ER) is presented. Refined methods are given for determining the character of the atmospheric circulation anomaly and the types of 500 mb fields in months which are extreme in temperature ratio for ER. Relationships are apparent which make it possible to construct a monthly forecast of the distribution of the sign of the anomalies over the country with a two month lead time, September included. The connections are examined between the considerable anomalies in September in ER, the character of zonal circulation in the troposphere in the Northern Hemisphere, and the heat state of the North Atlantic in the preceding months. The study was carried out with the observation data from 1946 to 1966. Author

N69-17097 National Lending Library for Science and Technology, Boston Spa (England).
ON THE VARIATION OF THUNDERSTORM ACTIVITY IN THE SOLAR CYCLE
E. P. Klejmenova [1968] 6 p refs In ENGLISH and RUSSIAN Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluzh., Met., Gidr. (Leningrad), no. 8, 1967 p 64–68
(NLL-M-7461-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.

Studies to determine the relation between solar activity and thunderstorms over the world are reviewed. Early investigations are mentioned, and data taken during the IGY and IQSY are emphasized. It is concluded that there is an antiphasal relation on the global scale, although Germany, China, and part of Africa exhibit a cophasal relation. The application of this relation to the theory of atmospheric electricity is also mentioned. N.E.N.

N69-17105 National Lending Library for Science and Technology, Boston Spa (England).
THE DEVELOPMENT OF A METHOD FOR 3–10 DAY METEOROLOGICAL FORECASTS FOR THE ARCTIC
L. A. Dydina [1968] 15 p refs In ENGLISH and RUSSIAN Transl. into ENGLISH from Probl. Arktiki Antarktiki, Sb. Statei (Leningrad), no. 27, 1967 p 114–122
(NLL-M-7454-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.

A review is presented of the development of 3–10 day and 8–10 day weather forecasts. It is pointed out that synoptic processes are about 1.5 times more changeable in the Arctic than in the middle latitudes. The development of the macrocirculation method is outlined, and its application to problem areas is described. These areas are the synoptic processes occurring in intervals of 3–4 days, the succession of types of synoptic processes and weather changes, the special features of the temperature-pressure field of the troposphere, and statistical methods of forecasting the circulation for 5–10 days. It is felt that at the present time the use of the macrocirculation method gives successful forecasts for 3 days and the first half of an 8–10 day period. N.E.N.

N69-17109 National Lending Library for Science and Technology, Boston Spa (England).
ON THE USE OF FORERUNNERS OF PRE-WINTER IN MAKING MONTHLY WEATHER FORECASTS
S. T. Pegova et al [1968] 11 p refs Transl. into ENGLISH from Gidromet. Nauch. Issled. Cent. SSSR (Leningrad), no. 23, 1968 p 3–12 In ENGLISH and RUSSIAN
(NLL-M-7460-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.

By analyzing the 700 mb charts for the distribution of troughs and ridges of the pre-winter seasons from 1938 to 1966, two predictors for the winter season were selected. The first was chosen from late summer, and the second from autumn. Both of these forerunners can be used to forecast the general character of the approaching season. The second predictor provides better results than the first. It is concluded that these forerunners can be used to forecast weather for October, November, and December, but should be used in conjunction with other prognostic indications. F.O.S.

N69-17111 National Lending Library for Science and Technology, Boston Spa (England).

THE FORECASTING VALUE OF FORERUNNERS OF NATURAL SYNOPTIC SEASONS

A. M. Aleshina [1968] 10 p refs Transl. into ENGLISH from Gidromet. Nauch. Issled. Cent. SSSR (Leningrad), no. 23, 1968 p 13–20 In ENGLISH and RUSSIAN

(NLL-M-7459-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.

The natural synoptic (NS) season is defined as an interval of time during which a definite character of the heat exchange between ocean and continent is maintained. This controls the similarity of most NS seasons in terms of the geographical distribution of the basic mean thickness fields in the troposphere. It has been established that in every NS season disturbances occur which are not typical of the season, and that these forerunners or predictors are often characteristic of the following NS season. A comparison was made of charts of mean H_{500} values for the forerunners and NS seasons using numerical parameters of similarity. The results show: (1) The forecasting value of both the first and the second forerunners is confirmed, with some preference attached to the second. (2) Identical forecasting value is shown for the first and second forerunners of the spring NS season. (3) The second forerunner is more useful than the first for the NS seasons of both the first half and second half of summer. (4) The first forerunner of the NS winter season is more useful for forecasting than the second. M.G.J.

N69-17112 National Lending Library for Science and Technology, Boston Spa (England).

THE ROLE OF THE NORTH ATLANTIC IN THE FORMATION OF SPRING–SUMMER AIR TEMPERATURE ANOMALIES IN THE EUROPEAN USSR

A. N. Kryndin [1968] 18 p refs Transl. into ENGLISH from Gidromet. Nauch. Issled. Cent. SSSR (Leningrad), no. 23, 1968 p 31–45 In ENGLISH and RUSSIAN

(NLL-M-7462-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.

The temperature changes in the ocean are compared with those in the atmosphere, and the role of ocean changes in the formation of spring–summer air temperature anomalies in the European U.S.S.R. is assessed. Temperature observations by North Atlantic weather ships for 1948 to 1965 are used for the comparisons. The results show that long-term air and water temperature variations are fully commensurable in amplitudes and deviations, and that annual and year-to-year fluctuations are of similar intensity. Consequently, the opinion favoring the incomparability of temperature variations in atmosphere and ocean is considered unjustified in view of the stability of the ocean field. The interrelationships between yearly and year-to-year temperature field fluctuations were also studied. It was found that the long term amplitudes of air and water temperature work out on average at 40% and 44% of the annual amplitudes; the standard deviations at ±11%. The temperature fields in the North Atlantic were analyzed to estimate the ocean's role in the formation of seasonal anomalies of air and water temperature on the continent. It is shown that temperature variations in the atmosphere and ocean possess specific features for different seasons, and that these must be considered in prognostic investigations. M.G.J.

N69-17121 National Lending Library for Science and Technology, Boston Spa (England).

ON THE POSSIBILITIES OF FORECASTING THE VARIATION OF AIR TEMPERATURE DURING A MONTH

D. A. Pod et al [1968] 31 p refs Transl. into ENGLISH from Gidromet. Nauch. Issled. Cent. SSSR (Leningrad), no. 4, 1967 p 91–114 In ENGLISH and RUSSIAN

(NLL-M-7458-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.

Existing methods of forecasting for a month are reviewed, and some statistical properties of the temperature field are discussed. As a result of these considerations a method of forecasting temperature for a month is given for the European USSR. Author

N69-17184 Environmental Science Services Administration, Silver Spring, Md. Air Resources Labs.

METEOROLOGY AND ATOMIC ENERGY, 1968

David H. Slade, ed. Oak Ridge, Tenn. AEC Jul. 1968 450 p refs Supported by AEC

(TID-24190) Avail: CFSTI

Studies of factors affecting radioactive atmospheric pollution are presented, and the relationship between meteorology and the nuclear industry is defined. Emphasis is placed on investigating the effects of atmospheric motions on suspended pollutants, the knowledge of which may be used in solving problems of health, safety, and economics arising from the peaceful exploitation of nuclear fission or fusion process. The role of a new field of meteorology, known as air pollution meteorology, which evolved with the development of the atomic energy industry, is discussed. Meteorological fundamentals relating to atmospheric transport and diffusion mechanisms within the lower layers of the atmosphere, an outline of theories, and a discussion of experiments on this subject are included. Atmospheric processes other than natural turbulence which affect effluent concentrations are investigated, and meteorological instruments for studying these effects, and other related phenomena, are discussed. Final topics include the concepts and techniques of radioactive cloud dose calculation and methods of environmental safety analysis. A.C.R.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N69-16363# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFRARED AND LIGHT WAVE AIRCRAFT HOMING AND GUIDANCE APPARATUS—SELECTED CHAPTERS

L. P. Lazarev 7 Mar. 1968 153 p refs Transl. into ENGLISH from the book "Infrakrasnyye i Svetovyye Pribory Samonavedeniya i Navedeniya Letatel'nykh Apparatov" Moscow, Izd. Mashinostr., 1966 p 3–4, 178–193, 278–388

(AD-679385; FTD-MT-24-2-68) Avail: CFSTI CSCL 17/7

The book discusses theoretical foundations and methods of design of infrared and visual aircraft homing and guidance systems, and their elements such as optical and optical-electronic systems, image analyzers, direction stabilizers, etc. Block diagrams of these devices are given. The problems of target and outer space

infrared radiation and its penetration into the atmosphere and cosmic space, and the foundations of aircraft collison theory are also analyzed. Author (TAB)

N69-16471*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A MARINER ORBITER AUTOPILOT DESIGN
E. H. Kopf 15 Jan. 1969 63 p
(Contract NAS7-100)
(NASA-CR-99278; JPL-TR-32-1349) Avail: CFSTI CSCL 22B

An autopilot for a Mariner orbiter, together with its design parameters, is presented. Autopilot design problems are defined, and the interfaces between the autopilot and spacecraft configuration and systems are described. Author

N69-16503*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PLANETARY PROBE GUIDANCE ACCURACY INFLUENCE FACTORS FOR CONJUNCTION-CLASS MISSIONS
Thomas B. Murtagh Washington Jan. 1969 42 p refs
(NASA-TN-D-4852) Avail: CFSTI CSCL 22C

The influence of spacecraft onboard radar data type and accuracy, of nominal entry trajectory parameters, and of planet radius uncertainty for unmanned planetary probe guidance is presented for a typical conjunction-class mission. The results of the analysis indicate that a probe guidance corridor on the order of 24 nautical miles can be obtained for a total midcourse velocity requirement less than 100 fps. The corridor results were more sensitive to variations in the nominal entry trajectory parameters than to variations in the assumed error in the radius of the target planet. Author

N69-16521# Federal Aviation Administration, Washington, D. C. Flight Standards Service.
NAVIGATION EQUIPMENT CAPABILITY PROGRAM (NECAP 2)
Leonard Pithan and Frank Parr Dec. 1968 71 p refs
(FS-66-250-57; SRDS-330-001-01N) Avail: Issuing Activity

The 214 VOR receivers in 111 aircraft were given bench, air-borne, and ramp checks to identify receiver error. The bench check error was found to be ± 4.1 degrees and the airborne error was ± 4.6 degrees (95% probability). Author

N69-16599# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SHIPBOARD RADAR
16 Feb. 1968 13 p Transl. into ENGLISH from Sudovoy Radiolokator (Moscow), 1965 p 1-11
(AD-678805; FTD-HT-23-1362-67) Avail: CFSTI CSCL 17/9

The navigational radar 'Stvor' is designed for installation on ships of the shipping fleet and also on marine and river boats of low and medium tonnage. A 'Stvor' station enables ships to navigate in zero visibility -- in fog, at night, etc. Because of its small blind zone and high angular resolution, 'Stvor' ensures safe sailing in canals, under irregular icing conditions, and within port areas. The value of 'Stvor' lies in the fact that it is light-weight, small, operationally reliable, and easily serviced. Information covering components, principle of action, shipboard arrangement, and basic data of the radar are included. Author (TAB)

N69-16949*# TRW Systems Group, Redondo Beach, Calif.
APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM. RANGE COVERAGE FOR THE CSM RENDEZVOUS RADAR TRANSPONDER ANTENNA RAISED 4° AND TILTED FORWARD 15°
Michael G. Doty 30 Sep. 1968 13 p
(Contract NAS9-8166)
(NASA-CR-92467; TRW-11176-H044-R0-00) Avail: CFSTI CSCL 22B

This document presents additional range coverage diagrams for the CSM Rendezvous Radar/Transponder (RR/T) using a different antenna configuration. Power measurements were made on a full-scale CSM model for all combinations of roll (ϕ) varying from 0° to 358° in 2° increments, and yaw (θ) varying from 0° to 180° in 2° increments. The coordinate system employed is shown. The new mounting system consisted of raising the RR/T Antenna Assembly 4" above the normal mounting position and tilting it 15° forward (toward $\theta = 0°$ axis). The measurements presented in this report are of the right-hand circular component of the radiated power. Author

N69-16962*# TRW Systems Group, Redondo Beach, Calif.
APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM. A COMPARISON OF THE COMPUTED LR RECEIVED SIGNAL SPECTRUM AND THE 1967 PEARL DATA
Dale E. Chambers 26 Nov. 1968 22 p refs
(Contract NAS9-8166)
(NASA-CR-92468; TRW-11176-H077-R0-00) Avail: CFSTI CSCL 17G

The similarities between experimentally measured power spectral density (PSD) curves of the signal returned from a rough scattering surface and the curves obtained from a computer program for a sinusoidal surface are discussed. The PSD of the signal returned from the lunar surface is a quantity needed to evaluate the performance of the landing radar. It is shown that the antenna pattern is the primary factor in determining the shape of the power density spectrum for low altitude flights. The specific geometry of the terrain can perturb the shape of the spectrum only slightly around the envelope of the antenna pattern. It was shown with the computer program that small attitude changes (3 deg) resulted in a large shift of the mean frequency (175 Hz). That is a possible explanation for the difference in the mean frequency between the measured and computed PSD curves in some cases. Otherwise, the general shape of the measured PSD curves can be predicted by the computer program using a sinusoidal surface to simulate the actual experimental site. Author

N69-17031*# TRW Systems Group, Redondo Beach, Calif.
APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM. LANDING RADAR ALTIMETER BEAM BANDWIDTH AND DOPPLER EQUATIONS FOR MATHEMATICAL MODEL USE
C. E. Blakely 25 Oct. 1968 15 p ref
(Contract NAS9-8166)
(NASA-CR-92466; TRW-11176-H059-R0-00) Avail: CFSTI CSCL 22B

The landing radar acquisition and logic circuitry was designed around a postulated reflectivity curve for the lunar surface, but surveyor data show that the lunar reflectivity may be as much as 12 dB larger. When a proposed reflectivity model for updating was employed in the landing radar mathematical models, the acquisition altitude was approximately 50% greater than that obtained with the old reflectivity model. This report contains the results of an investigation to determine why the acquisition altitude was not increased more than 50%. The results of the investigation show that the acquisition altitude of the radar is limited primarily by the doppler bandwidth of the altimeter. A second order effect is the spectral broadening due to the terrain scattering. The vehicle attitude is also important, however, this factor is consistent for both reflectivity models. The overall conclusion of this study is that the results of the simulation are correct. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N69-16116 *# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

USE OF FASTER CODE FOR SIGNIFICANTLY REDUCING DUCTED REACTOR SHIELD COMPUTATION TIME

Millard L. Wohl and Thomas M. Jordan (ART Res. Corp., Los Angeles, Calif.) Washington 1969 13 p refs

(NASA-TM-X-52521; E-4829) Avail: CFSTI CSCL 18F

The neutron number spectrum computed by the FASTER code at point detectors in a ducted water slab configuration is compared with similar results generated by the O5R code. Excellent agreement is found, verifying the quick-running FASTER code for this type of shielding analysis. Author

N69-16256 Maryland Univ., College Park.

DETERMINATION OF THE MOST-PROBABLE WAVELENGTH OF NEUTRONS AND THE ANGULAR SHIFT BY ROTATION OF THE DIFFRACTING CRYSTAL

Erol Akin (Ph.D. Thesis) 1967 94 p

Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-7005

A one centimeter square cross sectional collimated neutron beam was diffracted from the (200) planes of a sodium chloride (NaCl) single crystal (a = b = c = 5.623 Angstrom) with the crystal was stationary and while rotating with speeds of 1500, 2500 and 3500 rpm. The crystal was aligned with respect to the incoming beam and the BF_3 neutron detector, by rocking the crystal back and forth while keeping the neutron detector in a convenient position. At the maximum count rate, the sodium chloride crystal and the boron trifluoride (BF_3) neutron detector are locked then rotated in a 1 to 2 ratio to obtain the Maxwellian distribution. The clockwise and counter clockwise rotation of the sodium chloride diffracting crystal yield the 0.16, 0.32, and 0.48 degrees angular shift for the 1500, 2500, and 3500 rpm angular velocities, respectively. These angular shifts are the differences at the neutron distribution from the stationary diffracting crystal case. Dissert. Abstr.

N69-16361 # Naval Radiological Defense Lab., San Francisco, Calif.

GAMMA EXPOSURE RATES FROM A VARIETY OF AMBIENT OR NONAMBIENT CYLINDRICAL FISSION-PRODUCT SOURCES: A MODEL FOR THEIR CALCULATION

Frank H. Young 8 Oct. 1968 40 p refs

(AD-678727; NRDL-TR-68-88) Avail: CFSTI CSCL 18/8

A mathematical model is developed for the calculation of free-field gamma exposure rates from a variety of U235-mixed-fission-product sources. The source geometries considered include ambient or non-ambient cylindrical or annular sources, and an ambient cylindrical source encased in a non-ambient topped annulus. In the integration procedures, the self-attenuation of the sources is considered and time-dependent effective attenuation coefficients are employed to characterize the attenuation and absorption of the spectra of gamma photons emitted from the fission product radionuclides. The model is formulated in a manner suitable for numerical evaluation. Author (TAB)

N69-16381 *# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

REACTIVITY CHANGES OF A FAST REACTOR CORE DUE TO ELASTIC-PLASTIC STRAIN AND CREEP

Richard L. Puthoff Washington Jan. 1969 39 p refs

(NASA-TN-D-5012) Avail: CFSTI CSCL 18J

An elastic-plastic and creep analysis which predicts the actual core movement during the reactor operation and determines corresponding reactivity change is presented. A transport code was used for determining core reactivity. A reference design is included to aid in applying the analysis. The design consists of a 12-inch (30.48-cm) core containing uranium dioxide fuel surrounded by a 4-inch thick tungsten reflector. A reactivity decrease of −$3.85 resulted during the heating period with further reactivity decreases of −$0.06 during the first 90 hours and −$0.05 between 90 and 2000 hours. Author

N69-16462 *# Battelle Memorial Inst., Columbus, Ohio.

ANALYSIS OF RADIATION EFFECTS ON STORED LIQUID PROPELLANTS ON SPACECRAFT WITH AUXILIARY RTG OR NUCLEAR POWER SOURCES Final Report

J. F. Kircher, J. L. McFarling, E. R. Leach, R. E. Best, and J. D. Rollins 31 May 1968 44 p refs

(Contract NAS7-577)

(NASA-CR-99243) Avail: CFSTI CSCL 21I

An analysis of radiation effects on liquid propellants of interest as stored propellants on interplanetary unmanned spacecraft has been completed. Radiation damage data for 14 liquid fuels and 15 liquid oxidizers are tabulated. Radiation levels from external space radiation as well as representative α-, β-, γ-radioisotope and nuclear reactor power sources are presented in parametric form. A summary is given of propellant radiation damage as a function of source type and mission. It was concluded that α heat sources such as ^{238}Pu or ^{244}Cm probably would not require additional shielding to protect the propellants even with large power sources. β- and γ-radioisotope sources and nuclear reactor sources likely will require propellant shielding on long missions. Author

N69-16528 Michigan Univ., Ann Arbor.

MEASUREMENT OF DYNAMIC REACTOR PARAMETERS BY PHOTON OBSERVATION

Wayne Kutramo Lehto (Ph.D. Thesis) 1967 115 p

Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-7658

Fission rate fluctuations at low power in a reactor with a large fission product inventory were observed. A gaseous Cerenkov detector was used to sense the high energy prompt fission gamma rays in the presence of a fission product gamma field of 10^5 to 10^6 R/hr. The ratio β/γ is determined from the cross power spectral density of the fluctuations in the signals from two of these detectors. Both this spectrum and the power spectral density in the output of a single detector show a large low frequency component, attributed to moderator temperature fluctuations present when the fission product decay heat is removed by natural circulation of the coolant. The temperature fluctuations as measured with a short time constant thermocouple are shown to be correlated to those in the fission rate. A basis for calculating the performance of the detector is developed and a theory of the experiment is presented. The detector is described and improvements to the present model are outlined with suggestions for desirable future experiments. Dissert. Abstr.

N69-16590 # Oak Ridge National Lab., Tenn.

EXPERIMENTAL STUDY OF THE FABRICATION OF PLATE FUEL ELEMENTS CONTAINING A CERMET CORE

Jose Deodoro Trani Capocchi, Sebastiao Hermano Leite Cintra, and Erberto Francisco Gentile [1968] 22 p refs Transl. into ENGLISH from Met. (Brazil), v. 24, Mar. 1968 p 201–212
(ORNL-tr-1830) Avail: CFSTI

Fabrication procedures are described for reactor fuel element plates containing cores of Al–U_3O_8 dispersions with 55 to 75% concentrations of U_3O_8. The production of the cermet by powder metallurgy, the fabrication of the Al alloy-clad plates by rolling, and the quality control tests are presented. NSA

N69-16647# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
ASYGAD AND GADUP: PROGRAMS FOR STUDYING THE DEPLETION BEHAVIOUR OF SELF-SHIELDED BODIES OF GADOLINIA
R. H. Clarke Sep. 1968 44 p
(RD/B/N-1042) Avail: Issuing Activity

The codes ASYGAD and GADUP were programmed for the IBM 360/75 computer to perform the depletion calculation of self-shielded bodies of gadolinia in asymmetric neutron flux distribution. GADUP coded in CEGB Usercode, treats infinitely long bodies of any geometrical cross section which are lightly self-shielded, while ASYGAD, which is written in FORTRAN IV, treats highly self-shielded infinite cylinders. The programs were used to study the depletion of a variety of poison shapes, densities, and sizes varying from a few to 40 or 50 mean-free path diameters. Results are presented for the absorptive worth of the poisons, and also for the flux shapes and number density distributions through them. Author (NSA)

N69-16910# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUESTIONS OF THE PHYSICS OF REACTOR SHIELDING (SELECTED ARTICLES)
15 Nov. 1967 23 p refs Transl. into ENGLISH from the Publ. "Voprosy Fiziki Zashchity Reaktorov (Sbornik Statey)" Moscow, Atomizdat, 1966 p 104–120, 116–122
(AD-678791; FTD-MT-24-258-67) Avail: CFSTI CSCL 18/6

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N69-16911# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPECTRA OF FAST NEUTRONS IN METAL-WATER SHIELDING
D. L. Broder et al *In its* Questions of the Phys. of Reactor Shielding 15 Nov. 1967 p 1–14 refs (See N69-16910 06-22)
Avail: CFSTI

Neutron spectra in the energy range above 1 MeV were obtained from 3.35 and 14.9 MeV sources in water and in water behind layers of iron and lead, using a stilbene crystal scintillation spectrometer. The results show that the neutron spectrum from a mono-chromatic source in lead and iron differs considerably from that in water. The iron and lead spectrum shows a stronger concentration of low energy neutrons. In the energy range from 2 MeV to the initial energy of the 3.35 MeV source, and from 4–6 MeV to the initial energy of the 14.9 MeV source, the spectrum in water contains more neutrons than that in iron and lead. This explains the excellent shielding properties of iron and lead for fast neutrons, as well as their poor characteristics for comparatively low energy neutrons, and the excellent shielding properties of metal-water shielding throughout the entire energy spectrum. Spectra for neutrons in the energy region below the initial energy in water behind layers of lead and iron approach the shape of spectra in water at a thickness of greater than 20 cm. Author

N69-16912# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TITANIUM REMOVAL CROSS SECTION FOR A LAYER IN A HYDROGEN-CONTAINING MEDIUM
Yu. A. Yegorov et al *In its* Questions of the Phys. of Reactor Shielding 15 Nov. 1967 p 15–19 refs (See N69-16910 06-22)
Avail: CFSTI

Removal cross sections for titanium were measured in a water-water reactor of the swimming pool type. Sheets of titanium measuring 70×70 cm were placed near the reactor core with dimensions of 50×43×32 cm. The results show a removal cross section of 1.72 ± 0.06 barns. The removal cross sections determined for detectors with various effective energy thresholds from 1.1 to 7 MeV coincide within the limits of experimental error. The minimum distance from the plate used for the removal cross section depends on the effective threshold of the detector. For neutrons with an effective energy of 1.5 MeV in polyethylene, this distance is close to 15 cm. The distance decreases with an increase in the threshold. Author

N69-16959# RAND Corp., Santa Monica, Calif.
ACOUSTIC-GRAVITY WAVES PRODUCED BY ENERGY RELEASE
J. D. Cole and C. Greifinger Sep. 1968 40 p refs
(Contracts DAHC15-67-C-0141; F33657-69-C-0107)
(AD-678507; RM-5738-ARPA/AFT) Avail: CFSTI CSCL 18/3

A complete asymptotic analysis is carried out for the flow field produced by the instantaneous release of energy, at a point on the ground, in an isothermal atmosphere. A double integral representation of the flow is constructed from Laplace-Handel transforms of the linearized equations. An asymptotic approximation to the integral is obtained by two successive applications of the method of stationary phase. It is found that there are three principal groups of dispersive waves behind the spherical acoustic front. One of these groups is contained in a high frequency band, and the other two are contained in a low frequency band. The spatial domain of the low frequency waves is cut off by a front (caustic), the location of which is calculated. Some of the characteristics of the flow are discussed. Author (TAB)

N69-17117# Gulf General Atomic, San Diego, Calif.
HTGR FUEL REPROCESSING: EFFECTS OF INCLUDING A SILICON CARBIDE COATING ON FERTILE FUEL PARTICLES
J. J. Shefcik 10 May 1968 16 p refs
(Contract AT(04-3)-167)
(GAMD-8661) Avail: CFSTI

Conceptual flow sheets and reprocessing costs were developed for recovery of thorium and uranium from HTGR fuel elements containing silicon carbide-coated fissile and fertile particles. Two cases were considered. In Case IIIB the fertile particles were processed, and the fissile particles isolated, packaged and stored for eventual disposal or future processing. In Case IIIB1, both types of particles are processed to recover the contained uranium. Flow sheets and costs were derived from those contained in an earlier study where only the fissile particles had a silicon carbide coating. A modified burn-leach head-end process is used to prepare the fuel components for separation and decontamination by solvent extraction. The estimated costs associated with the two cases are listed. The reprocessing charges given assume plant operation at

its design capacity. No credit is included for the recovered thorium or fissile particle uranium. The incremental cost of recovery of the fissile particle uranium is $0.45. Author (NSA)

N69-17152# Argonne National Lab., Ill.
MEASUREMENT OF THE VELOCITY AND TEMPERATURE OF A LIQUID METAL COOLANT [IZMERENIE SKOROSTI I TEMPERATURY ZHIDKOMETALLICHESKOGO TEPLONOSITELYA]
V. I. Subbotin et al. Nov. 1968 3 p Transl. into ENGLISH from At. Energ. (USSR) (Moscow), no. 25, Issue 2, 1968 p 150–151
Sponsored by AEC
(ANL-Trans-690) Avail: CFSTI

An electromagnetic measurement method for investigating the hydrodynamic characteristics of complex channels which simulate the core of liquid metal cooled reactors is described. Small-scale flow meters used in combination with microthermocouples were developed, and results of experimental velocity and temperature measurements are presented. NSA

N69-17154# European Co. for the Chemical Processing of Irradiated Fuels, Mol (Belgium).
USE OF MASS-SPECTROMETRIC DATA FOR CALCULATION OF BURN-UP AND REACTOR CORE CONSTANTS
H. Bokelund Aug. 1968 23 p refs
(NP-17642; ETR-228) Avail: Issuing Activity

Data from isotopic analyses of U and Pu in dissolver solutions have been used to calculate fuel burnup, integrated neutron flux, conversion factors and ^{235}U capture-to-fission ratio for some reactors fueled with natural or low enriched U. The relation between the calculated atom percent fission and the integrated neutron flux is presented as a linear graph. Author (NSA)

N69-17159# Oak Ridge National Lab., Tenn.
REVIEW OF RADIOISOTOPES PROGRAM, 1967
J. H. Gillette et al. Nov. 1968 48 p refs
(Contract W-7405-ENG-26)
(ORNL-4329) Avail: CFSTI

Radioisotope preparations including ^{69m}Zn, ^{43}K, ^{92m}Nb, ^{33}P, ^{67}Cu, ^{95m}Tc, and ^{123}I are discussed. The feasibility and economics of producing ^{171}Tm as an isotopic power heat source were investigated. The high neutron flux capabilities of the HFIR were determined. The thermal neutron cross section and resonance integral of ^{140}Ba were determined to be 1.57 ± 0.3 and 13.6 ± 1.4 barns, respectively, and the effective cross section of ^{204}Tl was determined to be 23.1 barns. Thermal diffusion enrichment of the ^{85}Kr in the fission-product krypton provided 240 Ci of 13.97% ^{85}Kr and 370 Ci of 27.62% ^{85}Kr. Field tests with ^{133}Xe-tagged sand were carried out. Beta, low-energy secondary X-ray, and neutron sources were developed, fabricated, and characterized. The feasibility of producing ^{153}Gd in sufficient quantity and purity to be used for the Mars atmosphere density sensor source was determined, and alternative radioisotope sources were investigated. An experimental blood irradiator was designed and fabricated using ^{90}Sr. An ^{55}Fe source was prepared for use in an X-ray diffractometer. Author (NSA)

N69-17168# Gulf General Atomic, San Diego, Calif.
IRRADIATION EFFECTS ON HOT PRESSED BERYLLIUM OXIDE MATRIX FUEL BETWEEN 800 DEG AND 1600 DEG C
R. A. Meyer, F. H. Loftus, and R. C. Weed 15 May 1968 106 p refs Submitted for publication
(Contract AT(04-3)-167)
(GA-8559) Avail: CFSTI

A hot pressed BeO matrix, 5 vol-% UO_2 dispersion type fuel of 1/2 in. OD was irradiated in a fast flux exposure to 1.24 × 10^{21} nvt > 0.18 MeV with an energy density in excess of 125 W/cm and then evaluated for physical integrity, dimensional stability, and fission product retention capability to Xe, Kr, Sr, and Cs. The fuel was hot pressed between 1525 and 1700°C to densities in excess of 99% theoretical density. Additives of C, SiC, and SiO_2 were used to maintain grain size of the BeO between 3 and 5 microns. The irradiations were conducted at 800 to 1600°C to fissions per initial fissile atom (FIFA) values in excess of 30%, with equal amounts of fissions from ^{235}U and ^{239}Pu. Measurements during irradiation showed that the retention for Xe and Kr was between 10^{-6} at 800 and 10^{-5} at 1600°C. Postirradiation analyses showed that the retention of Sr was between 87 and 98%, but for Cs it was 67% at 1400 and 1600°C and ≈ 100% at 800 and 1100°C. Author (NSA)

N69-17167# Oak Ridge National Lab., Tenn. Office of Language Service.
EUROPEAN EXPERIMENTAL PROGRAMS OF FAST REACTORS AND FINAL REALIZATIONS
R. Hurst [1968] 13 p refs Transl. into ENGLISH from Energie Nucl. (Paris), v. 9, Jun.–Jul. 1967 p 271–274
(ORNL-TR-1783) Avail: CFSTI

The European programs for the development of fast reactors and their probable future are described briefly. NSA

N69-17173# Los Alamos Scientific Lab., N. Mex.
FISSION PRODUCT ENERGY RELEASE INVENTORY FROM Pu-239 FAST FISSION
M. E. Battat, Donald J. Dudziak, and H. R. Hicks 22 Oct. 1968 30 p refs
(Contract W-7405-ENG-36)
(LA-3954) Avail: CFSTI

By use of currently available experimental and calculated fission product yields from fast fission of ^{239}Pu, the fission product code, FPIC, has been expanded to include the capability of calculating fission product decay powers for ^{239}Pu fast fission. The revised code, FPIC/U–Pu, is operational on the CDC-6600 computer. Summation calculations of β,γ, and total decay powers from ^{235}U thermal fission and from ^{239}Pu fast fission were compared for both an instantaneous burst and infinite irradiation. Shutdown times ranged from 10 to 10^9 sec, and significant (>10%) differences occur principally for very short and very long shutdown times. The decay powers from ^{235}U thermal fission were compared with previous studies for an instantaneous burst and for infinite irradiation, and good agreement was found over the applicable shutdown times. Author (NSA)

N69-17175# Idaho Nuclear Corp., Idaho Falls.
RECENT RESEARCH ON THORIUM AT THE MATERIALS TESTING REACTOR
Robert G. Nisle Sep. 1968 45 p refs
(Contract AT(10-1)-1230)
(IN-1254) Avail: CFSTI

The concept of a composite equilibrium, analogous to the "transient equilibrium" of Evans, is developed and shown to be useful for continuous irradiations. The sensitivity of its value to cycled irradiations and its limitations under conditions of randomly interrupted irradiations are pointed out. Problems of flux level and spectrum measurement during irradiation are discussed and areas where improvements are needed are indicated. A sizeable portion of the effort was devoted to the development of calculational techniques for the interpretation of the data. These involve adjustment of results to account for effects that could not be measured directly, but could be inferred from reactor core type calculations. Still other calculational techniques deal with calibration of reactivity

response versus sample content and prediction of reactivity changes during 233Pa decay. These in themselves constitute a contribution to the art aside from the validity of the numerical results obtained. Author (NSA)

N69-17176# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
TOTAL ENERGY DEPOSITION RATES IN A GRAPHITE MODERATOR WITH TWO DIFFERENT FUELS
G. E. Hanson 30 Aug. 1968 18 p refs
(Contract AT(45-1)-1830)
(BNWL-898) Avail: CFSTI

Graphite heating calculations are given for two water cooled tubular U fuel elements surrounded by graphite. Methods used for calculations are described; space and energy effects are considered. Dimensions and nuclei densities are given for the fuel elements used in the calculations. NSA

N69-17177# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PLUTONIUM DIOXIDE GAMMA ATTENUATION MEASUREMENTS THROUGH STEEL
L. W. Brackenbush Jul. 1968 16 p
(Contract AT(45-1)-1830)
(BNWL-871) Avail: CFSTI

Photon dose-rates and energy spectra of two plutonium dioxide samples were measured, and attenuation measurements made with thin stainless steel absorbers. Relatively low exposure (≈10% ^{240}Pu) and high exposure (≈23% ^{240}Pu) plutonium samples were used. The surface dose rates from the two samples measured through plastic bags were 1.7 rad/hr and 4.6 rad/hr; the dose rates were reduced to 0.55 rad/hr and 1.55 rad/hr, respectively, by 0.020 inches of steel. Spectral measurements show 0.020 inches of steel eliminates most of the activity below 30 keV and appreciably attenuates the activity below 60 keV. Transmission ratios for a pure ^{241}Am source through steel absorbers are also presented. Author (NSA)

N69-17178# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
GEOMETRY PROBLEMS ENCOUNTERED IN DESIGN OF THE FFTF SPLIT CONICAL CORE
L. M. Finch, R. E. Peterson, and G. R. Waymire 9 Nov. 1967 36 p Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago
(Contract AT(45-1)-1830)
(BNWL-SA-1323; CONF-671102-45) Avail: CFSTI

The conceptual designs for the Fast Flux Test Facility included vertical, skewed, and split conical core configurations. Evaluation of the proposals led to the selection of the split conical core. Core design activity after selection of the conceptual design was concerned with improving the geometry and fuel design to achieve the maximum obtainable flux. Geometric problems encountered in the optimization effort and the final selected core configuration are described. NSA

N69-17179# Atomic Energy Establishment, Winfrith (England).
LECTURE NOTES ON SELECTED TOPICS IN NUMERICAL METHODS IN REACTOR PHYSICS
F. J. Fayers Sep. 1966 66 p refs
(AEEW-M-677) Avail: CFSTI

Presented are notes prepared as part of a set of lectures on reactor physics given at Birmingham University. The topics treated are: calculation and use of collision probabilities in reactor physics; numerical solution of the few-group diffusion equation in two-space dimensions; and numerical solution of the transport equation by the Carlson S_n-method. NSA

N69-17180# General Electric Co., San Jose, Calif. Nuclear Fuels Dept.
ZIRCALOY-CLAD UO_2 FUEL ROD EVALUATION PROGRAM Quarterly Progress Report, May-Jul. 1968
F. H. Megerth, comp. Aug. 1968 28 p
(Contract AT(04-3)-189)
(GEAP-5667; QPR-3) Avail: CFSTI

Fuel element performance for the Dresden Power Reactor Unit 1 Assembly SA-1 is analyzed. Crud and ZrO_2 depositions on the Zircaloy 2-clad UO_2 fuel elements are described and illustrated. Fuel element isotopic compositions are presented. NSA

N69-17200# Atlantic Richfield Hanford Co., Richland, Wash.
CRITICALITY HANDBOOK, VOLUME 1
R. D. Carter, G. R. Kiel, and K. R. Ridgeway 30 Jun. 1968 253 p
(Contract AT(45-1)-2130)
(ARH-600-Vol-1) Avail: CFSTI

Topics discussed include: administration; engineering data; homogeneous systems; heterogeneous systems; interaction; and poisons. NSA

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N69-16124 Arizona Univ., Tucson.
A THEORETICAL STUDY OF THE DYNAMICS OF A VARIABLE MASS SYSTEM (APPLIED TO AEROBEE ROCKET)
Virgil Ward Snyder (Ph.D. Thesis) 1968 144 p ref
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-8310

Precise definitions are established and carried through the derivation of the equations. Familiar terms such as momentum, force, etc., are identified for a specific system to eliminate confusion. With these definitions as the preliminaries and classical field theory as the mathematical foundation, the equation sought may be derived without relying on physical intuition. The classical laws of mechanics are postulated in a Newtonian sense and are consistent with continuum concepts. The system under study, identified as the variable mass system, is a geometric manifold which is moving through Euclidean three dimensional space. The system is selected independent of the material which it may contain. The variable mass character of the system is due to a flux of mass across the surface of the geometric manifold and the non-rigid character of the mass contained within the manifold. The equations of motion for the variable mass system are derived in general. Dissert. Abstr.

N69-16205 Illinois Univ., Urbana.
A ONE-DIMENSIONAL APPROXIMATION FOR THE ATTENUATION OF ULTRASONIC WAVES IN A SOLID
Thomas Joseph Bander (Ph.D. Thesis) 1967 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-8022

An attempt is made to approximate the attenuation of ultrasonic waves in a solid material using a one dimensional model

consisting of a chain of individual masses connected together by nonlinear springs and dashpots. A series of nonlinear differential equations is obtained and a solution using the method of Kryloff and Bogoliuboff is developed. Two cases are considered for the functions represented by the nonlinear springs and dashpots. The first case used springs which were linear and cubic in differences of displacement and dashpots which were linear and cubic in differences of velocity. The second case used springs which were linear and quadratic in differences of displacement and dashpots which were linear and cubic in differences of velocity. Dissert. Abstr.

N69-16252# Houston Univ., Tex. Dept. of Mechanical Engineering.
MODE RESPONSE OF A SINUSOIDALLY EXCITED, CIRCULAR BIMORPH
W. S. Mitchell and D. Muster Jun. 1968 30 p refs
(Contract Nonr-4492(01))
(AD-678744; TR-5) Avail: CFSTI CSCL 20/1

In a series of recent experiments it was observed that the response of underwater horns cannot be predicted by a simple theory. In a subsequent investigation a more detailed description of the response of the horn driver (a circular piezoelectric ceramic Bimorph) was sought. The results of the later investigation are reported here. The dynamic behavior of thin vibrating plates has been the subject of considerable study. This has been done experimentally by means of sand patterns and, in the case of piezoelectric materials (such as quartz), by interferometric techniques. Some results of establishing sand patterns on a sinusoidally driven piezoelectric plate made from ceramic material (PZT4) are given here. It was found that the response of a ceramic thick plate does not obey thin-plate theory, as was noted previously by A. B. Wood with respect to thick steel discs. In addition, thick circular discs apparently do not produce nodal diameters across a vibrating surface. Asymmetric supports apparently cause an increase in acoustic output when compared to symmetrically supported devices. Author (TAB)

N69-16283 National Lending Library for Science and Technology, Boston Spa (England).
MOISTURE-PROOF INTERFERENCE LIGHT FILTERS [VLAGOSTOIKIE INTERFERENTSIONNYE SVETOFILTRY]
T. V. Pozdneva et al Oct. 1968 5 p Transl. into ENGLISH from Svetotekhnika (USSR), v. 12, no. 6, 1966 p 26–28
(NLL-RTS-4574) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d

The light filters described were obtained by depositing a many-layered coating on a glass surface by vaporizing magnesium fluoride, zinc sulfide, and titanium in a vacuum. Titanium was used as an outer strengthening layer. To protect the interference layer from the effects of moist surroundings and the filters from radiant flux density, a shielding method was developed to ensure continuous use of the filter in water. The method selected involved cementing together the interference filter with clear glass, making sure that the interference layer is hermetically sealed in close contact. Autoclave compression was used to cement a butafoil film to the glass plate. Experiments show that the hermetic sealing method enables interference filters to be used at temperatures up to 40°C with continuous water washing of the outer surfaces; the spectral transmission coefficients of the filters are unchanged. M.G.J.

N69-16385# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTOMETRIC EQUIPMENT FOR PULSED LIGHT SOURCES
V. P. Yefremov et al 1 Mar. 1968 13 p refs Transl. into ENGLISH from Svetotekhnika (Moscow), no. 6, 1966 p 22–24
(AD-678820; FTD-MT-24-18-68) Avail: CFSTI CSCL 20/6

A unit for photometric measurement of pulsed light sources is described. This unit consists of three instruments: an FIL photometer for flash lamps, an FML-m photometer for lasers and a KOS standard light pulse generator. The FIL photometer may be used for measuring nearly all types of industrial flash tubes and the FML-m is used for measuring the radiation from free-emission lasers. The KOS instrument generates reproducible standard light pulses and is used for calibration of the two photometers. The flash tube photometer may be used for measuring the luminous intensity of a light source with a maximum transverse dimension of 110 mm. TAB

N69-16594# Dartmouth Coll., Hanover, N. H.
COLOR CENTERS AND THE THERMOLUMINESCENCE PROGRESS IN LiF:Mg
M. R. Mayhugh, R. W. Christy, and N. M. Johnson 30 Sep. 1968 12 p refs Presented at the 2nd Intern. Conf. on Luminescence Dosimetry, Gatlinburg, Tenn.
(Contract AT(30-1)-3474)
NYO-3474-5; CONF-680920-4) Avail: CFSTI

A systematic study of radiation-induced color centers in LiF:Mg has been made at low dose to help understand the thermoluminescence mechanism in this material. Important Mg-related optical absorption was observed from 310 to 380 nm. In particular the main thermoluminescence dosimetry peak is associated with the centers which produce a 310 nm absorption band. Furthermore, the thermoluminescence mechanism is this glow peak and two related ones is shown to involve electrons which are thermally released from 310 nm centers. This identification is made from the results of 310 and 250 nm optical bleaching experiments on thermoluminescence samples. Author (NSA)

N69-16620# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MIXING EFFECTIVENESS OF DIFFERENTIALLY POLARIZED LIGHT WAVES ON UNIAXIAL NONLINEAR CRYSTALS
B. V. Bokut' et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 70–75 refs (See N69-16610 06-34)
Avail: CFSTI

General expressions are derived for the nonlinear interaction coefficients for three methods of mixing light waves on uniaxial crystals in directions of phase agreement. Comparison of these coefficients with one another makes it possible to select the most efficient method of mixing the waves. This comparison is made for the case of difference-frequency generation on a lithium niobate crystal and generation of sum frequency of a KDP crystal for mixing of emissions of ruby and neodymium lasers. Author

N69-16630# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF THE PRINCIPAL OPTICAL CHARACTERISTICS OF ABSORBING LAYERS
I. A. Tekucheva *In its* J. of Appl. Spectry. 17 Jan. 1968 p 144–149 refs (See N69-16610 06-34)
Avail: CFSTI

A new method is proposed for the determination of the refractive index and absorption coefficient of a thin coating deposited on a substrate. The method is based on calculations and approximations and involves a comparison of the light transmitted through the sample and reflected from it. Calculations were made for titanium oxide amorphous films of 400 Å thickness, deposited on quartz substrates and tested near the long wave edge of the intrinsic absorption band, under several approximations for the transparency of the film. All calculations yielded close results, indicating that the method has a wide range of applicability. Author

N69-16667 National Lending Library for Science and Technology, Boston Spa (England).
SOME PROPERTIES OF A REFLECTING SURFACE
G. B. Tkachuk Oct. 1968 10 p refs Transl. into ENGLISH from Svetotekhnika (Moscow), v. 12, no. 6, 1966 p 13–16
(NLL-RTS-4570) Avail: Natl. Lending Library, Boston Spa, Engl.: 12s

A discussion is presented on the reflection functions necessary to characterize the reflecting power of a surface. The characteristics of luminance coefficient, coefficient of luminous intensity, and reflection coefficient are formulated, and two principles are examined which affect the properties of the reflecting medium: the principle of optical reversibility, and the principle of detailed balance. Methods of obtaining values for these functions, as well as their interrelationships and use in determining the optical properties of the reflecting surface, are also described. A.C.R.

N69-16672 National Lending Library for Science and Technology, Boston Spa (England).
A PHOTOMETRIC INSTRUMENT FOR IMPULSE LIGHT SOURCES [FOTOMETRICHESKAYA APPARATURA DLYA IMPUL'SNYKH ISTOCHNIKOV SVETA]
A. A. Vol'kenshtein Oct. 1968 7 p refs Transl. into ENGLISH from Svetotekhnika (Moscow), v. 12, no. 6, 1966 p 22–24
(NLL-RTS-4572) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d

The design and operation of an impulse photometric instrument are described. The complete instrument consists of three units: a photometer for pulsed lamps; a photometer for optical quanta generators using a photomultiplier tube; and a standard light pulse generator, or controlled light source. The pulsed lamp photometer measures the amplitude of intense light pulses, illumination and brilliance, or the integral with time of these quantities. The second photometer enables laser radiation to be measured with independent generation. The standard generator radiates perfectly reproducible light pulses and is used for periodic calibration of the other two components. It was determined that this assembly of instruments will not measure the whole range of light sources required for impulse photometry under its present design. A.C.R.

N69-16699# RAND Corp., Santa Monica, Calif.
OPTICAL PROPAGATION IN A WEAKLY INHOMOGENEOUS MEDIUM
H. T. Yura Nov. 1968 39 p refs Submitted for publication
(AD-678990; P-3944) Avail: CFSTI CSCL 20/6

A self-consistent Greens function technique is used to obtain the electromagnetic field and its corresponding intensity to second order in the index of refraction fluctuations. The qualitative results of the analysis are: for propagation distances R less than a critical range Rc, the perturbation method gives valid results. For R Rc the field is primarily coherent since the fluctuations in the field are small. It is demonstrated that the solution obtained for the field conserves energy. Physically, the energy removed from the average field is transferred to the random fluctuating part of the field. A solution is found for the second Rytov approximation which is correct through terms second order in the n1, where n1 is the fluctuating part of the index of refraction. With this solution a condition of validity on the Rytov approximation is obtained. It is concluded that the Rytov and Born approximations have the same domain of validity -- both valid only for R Rc. For R > Rc the perturbative method breaks down; the field is essentially incoherent since the coherent part of the field is exponentially small. For these range values a statistical argument is given to obtain intensity statistics, and an approximate expression valid for all values of R is derived for the intensity statistics and compared with experiment. It is found that the agreement is good. Author (TAB)

N69-16751 California Univ., Los Angeles.
COHERENCE LIMITATIONS ON HOLOGRAPHIC SYSTEMS
Emmanuel John's Vourgourakis (Ph.D. Thesis) 1967 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-7490

This dissertation is concerned with the limitations imposed on the holographic process by partially coherent illumination. Attention is focused on the representation of the holographic process as an input-output relationship. The holographic process is considered (for the first time apparently) as a system composed of a reference source, a photographic emulsion, and a readout source, all fixed with respect to each other. The point spread function (equivalent to the weighting function in filtering theory) is obtained, and in certain cases the modulation transfer function of the holographic system. All the known properties of the holographic process can be derived from this characterization, and for instance, it is no longer necessary to differentiate between Fresnel, Fraunhoffer, and Fourier holograms as distinct entities. Dissert. Abstr.

N69-16763 National Lending Library for Science and Technology, Boston Spa (England).
THE USE OF SELENIUM PHOTOCELLS FOR MEASURING VARIABLE LIGHT FLUX [PRIMENIE SELENOVYKH FOTOELEMENTOV DLYA IZMERENIYA PEREMENNYKH SVETOVYKH POTOKOV]
A. M. Fomina Oct. 1968 5 p refs Transl. into ENGLISH from Svetotekhenika (USSR), v. 12, no. 6, 1966 p 24–26
(NLL-RTS-4573) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d

The characteristics of various types of selenium photocells, at light flicker frequencies of 25 to 8200 Hz, were examined. The light flux from an incandescent lamp was modulated by means of a rotating disc with circular or trapezoidal apertures. The number of apertures in the disc, together with the speed of rotation of the electric motor, determined the modulation frequency. The speed of disc rotation was measured with a strobotachometer and the mean values of the photocell current with a microammeter. The deviation from Talbot's law is deduced by comparing the measured values of the transmission coefficient of the disc with the theoretical value calculated from measurement of the apertures of the disc. The data show that selenium photocells do conform to Talbot's law, within the limits of the measurement range, to an error not exceeding 1%. M.G.J.

N69-16845# Army Electronics Command, Fort Monmouth, N. J.
ORIGIN OF THE DISPERSION OF THE COMPLEX MAGNETIC PERMEABILITY IN SPINEL FERRITES
Walter W. Malinofsky Jul. 1968 120 p refs
(AD-678485; ECOM-2973) Avail: CFSTI CSCL 20/3

Measurements of the complex magnetic (initial) permeability of spinel ferrites performed as a function of frequency demonstrate a dispersion at radio frequencies as first observed by Snoek. An additional dispersion at microwave frequencies was first observed by Radio. Various theories have been proposed to explain the mechanism of dispersion. This report analyzes these theories and draws conclusions about the validity of the proposed mechanisms. Author (TAB)

N69-16855# State Univ. of New York at Buffalo. Div. of Interdisciplinary Studies and Research.
ON THE TRANSMISSION OF PLANE WAVES THROUGH LAYERED LINEAR VISCOELASTIC MEDIA
Richard P. Shaw and Paul Bugl Aug. 1968 19 p refs
(Contract Nonr-4449(00))
(AD-678853; Rept-42) Avail: CFSTI CSCL 20/4

The two dimensional propagation of time harmonic waves through a plane horizontally layered viscoelastic medium is discussed. The problem is formulated as the equivalent elastic plane strain case with modified lame constants, which are complex and frequency dependent, replacing the usual elastic lame constants. Rather than using potentials, incident angles, etc., the problem is formulated directly in terms of stresses and displacements and solved using matrix methods. This approach is felt to be more direct and leads to some interesting conclusions. Author (TAB)

N69-16922# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
INVESTIGATION ON THE NOISE EVOLUTION OF TURBULENT FREE JETS
F. R. Grosche [1969] 73 p refs In ENGLISH
Avail: CFSTI

A method of investigating sound source distribution in turbulent jets was tested at the jet noise stand. The sound sources are reflected in this process on a microphone located outside of the jet by means of a spherical (concave) reflector. Preliminary results of measurements on a circular nozzle and on slotted nozzles without and with screening shields are indicated. Author

N69-16982# Stanford Univ., Calif. Microwave Lab.
MICROWAVE RESEARCH Quarterly Status Report, 1 May–31 Jul. 1968
C. F. Quate, B. A. Auld, J. H. Collins, R. H. Pantell, and H. Heffner Sep. 1968 48 p refs
(Contract Nonr-225(48))
(AD-678731; ML-1682; QSR-38) Avail: CFSTI CSCL 20/1

This report is the thirty-eighth Quarterly Status Report for the six projects active under this contract: (I) Acoustic Microscope; (II) Electronic Focusing in Acoustic Delay Lines; (III) Acoustic Surface Wave Amplification; (IV) Stimulated Compton Scattering; (V) Submillimeter Wave Generator; (VI) Theory of Thin Film Waveguides. Author (TAB)

N69-17019# Tennessee Univ., Knoxville. Ultrasonics Lab.
LATERAL DISPLACEMENT OF AN ULTRASONIC BEAM UPON REFLECTION FROM A SOLID IMMERSED IN A LIQUID
Richard Frederick Smith Dec. 1968 67 p refs
(Contract Nonr-4289(01))
(AD-678913; TR-6) Avail: CFSTI CSCL 20/1

When an ultrasonic wave of finite cross section is reflected from a liquid-solid interface, a lateral displacement of the reflected beam parallel to the interface results for specific angles of incidence. Adapting the theory for reflection of a longitudinal wave from a liquid-solid interface to account for the finite width of the ultrasonic beam allows one to predict the magnitude of this displacement. A decrease in measured energy ratio reported by previous investigators is caused by the displaced reflected beams partially or totally missing a receiving transducer. Measurement of the energy ratio after tracking the displaced beam leads to results that are in good agreement with theory. An analytic expression for beam displacement is developed for incident angles greater than the critical angle for shear wave generation. Plots of beam displacement over all incident angles are presented from computer data. Experimental measurements are reported for the reflected energy ratio and the beam displacement occurring upon reflection of a longitudinal wave from samples of aluminum and duralumin immersed in water. The amplitude cross section of the reflected beam is mapped out for reflection from beryllium in water. Author (TAB)

N69-17024# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
MICROPOLAR VISCOELASTIC WAVES
Matthew F. McCarthy and A. Cemal Eringen Aug. 1968 26 p refs
(Contract N00014-67-A-0151)
(AD-678648; TR-5) Avail: CFSTI CSCL 20/14

The propagation conditions and growth equations, which govern the propagation of waves in micropolar viscoelasticity, are derived and discussed. The couplings between the discontinuities in the macroscopic and microscopic fields are studied. Author (TAB)

N69-17067# Army Biological Labs., Fort Detrick, Md.
THREE DIMENSIONAL DIFFRACTION PROBLEM FOR ELECTROMAGNETIC OSCILLATIONS
D. Z. Avazashvili Jul. 1968 10 p refs Transl. into ENGLISH from Soobshcheniya Akad. Nauk Gruzin. SSR (Tiflis), v. 14, no. 6, 1953 p 321–328
(AD-678900; Trans-569) Avail: CFSTI CSCL 20/14

The paper considers the problem of diffraction in a three-dimensional space, following the basic method used by Kuprodze to solve the plane problem of the diffraction of electromagnetic waves. Author (TAB)

N69-17087# Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
THE MEANINGFUL USE OF THE SECCHI DISC
Jerome Williams Nov. 1968 18 p refs
(Contract Nonr-4010(11))
(AD-679166; TR-45; Ref-68-15) Avail: CFSTI CSCL 20/6

The Secchi Disc is examined in terms of a target seen by the human eye under threshold contrast conditions. Results indicate that the Secchi Disc Reading is related to both the extinction coefficient and the beam transmittance coefficient. There appears to be no way to separate the two from the use of the Secchi Disc alone. In addition, if these readings are to have any meaning at all it is strongly indicated that an optical filter be placed in the system when readings are taken. Special colored glasses are suggested for this purpose. Author (TAB)

N69-17185*# Techtran Corp., Glen Burnie, Md.
COMPRESSIVE FORCES OF LIGHT ON GASES [DIE DRUCKKRAFTE DES LICHTES AUF GASE]
Peter. Lebedew Washington NASA Jan. 1969 20 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 32, 1911 p 411–437
(Contract NASw-1695)
(NASA-TT-F-12066) Avail: CFSTI CSCL 20F

The existence of compressive forces of light on gases was experimentally determined. These compressive forces are directly proportional to the incident amount of energy and the absorption coefficient of the gas mass. Within the possible errors for these experiments and calculations, the relationship established by Fitzgerald is to be considered quantitatively proven. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N69-16131 Pennsylvania Univ., University Park.
NMR SPECTRA OF FLUOROMETHANE MOLECULES IN A LIQUID CRYSTAL SOLVENT
Bernard James Lavery (Ph.D. Thesis) 1967 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-8718

NMR spectra of the molecules CH_3F, CH_2F_2, and CHF_3 were analyzed in the liquid crystal solvent p,p'-di-n-hexyloxyazoxybenzene. From a comparison of the direct dipole–dipole interaction, which is orientation dependent, with the indirect spin–spin interaction which is orientation independent, it is possible to determine the absolute sign of the indirect spin–spin coupling constant J_{HF}. Furthermore, a comparison of the chemical shift in the isotropic phase with that in the nematic phase for a particular average orientation makes possible the determination of the anisotropy of the magnetic shielding tensor. Dissert. Abstr.

N69-16136 IIT Research Inst., Chicago Ill.
A MECHANISM FOR OPTICAL GENERATION OF SOLVATED ELECTRONS
Karl John Youtsey (Ph.D. Thesis) 1967 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-10132

Information was obtained on the primary steps in the photoionization of aromatic molecules in fluid media. The new experimental results are based on measurements of: (1) the initial free radical yields after flash photolysis of p-cresol in the presence of scavengers in aqueous solutions and as a function of temperature in water, methanol, and ethanol; and (2) the temperature dependence of the p-cresol fluorescence in water and methanol. It was found that addition of either nitrous oxide or methanol to aqueous p-cresol at pH 7 causes an increase in the initial p-methylphenoxyl yield and that a similar increase is caused by the addition of nitrous oxide to solutions of p-cresolate anion at pH 12. The initial radical yield from the neutral molecule decreases linearly with increasing temperature and is approximately constant in nitrous oxide-saturated solutions, while from the anion the initial radical yield is constant at pH 12 and increases linearly with temperature in nitrous oxide-saturated solutions. Dissert. Abstr.

N69-16137 Princeton Univ., N. J.
THE METHOD OF MOLECULAR ORBITAL MINUS IONIC STATES
Raymond Kapral (Ph.D. Thesis) 1968 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-9682

The effects of the constraints imposed by the restricted functional form of a single determinant of doubly occupied orbitals have been examined in some detail. The analysis has been carried out by means of an expansion of the molecular orbital function into a linear combination of valence bond determinants. In terms of this picture, the molecular orbital function is often found to be a vector in a subspace of the vector space whose basis consists of all valence bond configurations of proper symmetry. In addition, it is not the optimum vector in this subspace. In the case of noble gas compounds with $D_{\infty h}$ symmetry, these constraints may be severe enough to render the molecular orbital method incapable of distinguishing between attractive and repulsive potential surfaces. A study of the nitrogen and boron fluoride molecules has also been carried out. The triple bond character of these systems is responsible for much of the difficulty associated with a straightforward valence bond calculation. Dissert. Abstr.

N69-16138 California Univ., Riverside.
PART 1: EXCITED STATE INTERACTIONS AND ENERGY TRANSFER IN PYRENE MOLECULAR CRYSTALS. PART 2: THE QUENCHING OF ORGANIC TRIPLET STATES BY MOLECULAR OXYGEN
Kenji Kawaoka (Ph.D. Thesis) 1967 388 p
Avail: Univ. Microfilms: HC $16.65/Microfilm $4.70 Order No. 68-9759

The excited state interactions between pyrene and perylene and the energy transfer processes of pyrene molecular crystals is experimentally examined. A study of the emission and absorption properties of perylene in the presence of pyrene in crystalline and fluid media indicate that there are significant non-resonance interactions between perylene and pyrene. This result supports the hypothesis that nonresonance interactions, which may include those of charge transfer origin, contribute to the observed stabilization of the pyrene excited state dimer. The quenching of triplet-state molecules by molecular oxygen is examined theoretically. Two different quenching processes are considered: (1) quenching by transfer of electronic excitation energy from the triplet state of the donor molecule to oxygen, resulting in a ground-state donor molecule and an electronically excited singlet-state oxygen molecule; and (2) quenching by enhancement of intersystem crossing in the donor molecule, resulting in a vibrationally excited donor molecule in its ground electronic state and a ground-state oxygen molecule. Dissert. Abstr.

N69-16148 Florida State Univ., Tallahassee.
RADIATIVE AND NONRADIATIVE TRANSITIONS BETWEEN ELECTRONIC STATES OF POLYATOMIC MOLECULES
Bryan Roger Henry (Ph.D. Thesis) 1967 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-7793

Theoretical investigations of radiationless processes in polyatomic molecules and upper triplet states of polyatomic molecules, with special emphasis on the location of lower excited triplets, were conducted. A summary of existing theories of radiationless transitions was carried out, and it is shown that for all the theories where the perturbation causing radiationless transitions is intramolecular in character, the origin of the perturbation arises from the failure of the Born–Oppenheimer approximation. Conceptual difficulties associated with a time dependent approach to radiationless transitions were pointed out. A stationary state approach to radiationless transitions was described. A technique was developed to extend triplet–triplet (T–T) absorption spectroscopy to the near infrared regions of the spectrum by the method of steady cross-illumination. Eight new T–T transitions were found. Because of the relatively small attention that has been given previously to T–T absorption in heterocyclic molecules, many such molecules were investigated, and new transitions were discovered. Criteria for T–T absorption were examined and listed, and molecular mechanisms for increasing the probability of T–T absorption were delineated. In particular, the effect of changing the strength of the spin-orbital perturbation in the system was analyzed in detail. Dissert. Abstr.

N69-16149 Ohio State Univ., Columbus.
PHYSICS, MOLECULAR SPECTROSCOPY: THE ROTATIONAL SPECTRUM OF HYDROGEN SULFIDE
Richard Eugene Gillespie (Ph.D. Thesis) 1967 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-9825

The pure rotational absorption spectrum of hydrogen sulfide was measured in the spectral region between 10 cm^{-1} and 125 cm^{-1} using a far infrared grating spectrometer. Resolution of approximately 0.2 cm^{-1} was obtained using a bolometer at liquid helium temperature. An IBM 7094 computer calculated the hydrogen sulfide spectrum from the established theory for a non-rigid asymmetric rotor. The calculated and the observed spectrum were found to be in good agreement. As the result of this work, the far infrared absorption spectrum of hydrogen sulfide was found to be predictable to within the experimental accuracy of the frequency measurements, which was better than 0.05 cm^{-1}. Dissert. Abstr.

N69-16157# Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.
ELECTRON SCAVENGING PROCESSES IN THE RADIOLYSIS OF HYDROCARBON SOLUTIONS
John M. Warman, K.-D. Asmus, and Robert H. Schuler 26 Jan. 1968 62 p refs Presented at the Intern. Conf. on Radiation Chem., Argonne, Ill., Aug. 1968
(Contract AT(30-1)-2310)
(RRL-2310-226; CONF-680806-4) Avail: CFSTI

The current state of knowledge of electron scavenging processes in liquid hydrocarbons is summarized. The interpretation of data is critically discussed in the light of possible complicating factors. The relation $G(S^-) = G_0 + G_0(\alpha_s [S])^{1/2} / (1 + (\alpha_s [S])^{1/2})$ is found to describe the concentration dependence of electron scavenging in a number of cases. Using this relation it is shown that a detailed treatment of the scavenging kinetics in competitive situations is possible. Secondary reactions involving negative ions are postulated to explain anomalies found in the available data. Author (NSA)

N69-16160# Maryland Univ., College Park. Inst. for Molecular Physics.
INVESTIGATIONS OF N2 BAND SYSTEMS PROMINENT IN ELECTRIC DISCHARGES. Final Report, 1 Feb. 1963–1 Feb. 1968
William M. Benesch Mar. 1968 13 p
(Contract AF 19(628)-2819)
(AD-679214; AFCRL-68-0565) Avail: CFSTI CSCL 7/4

The interest in the molecular band systems of nitrogen as discussed has grown out of two lines of investigation. One of the programs was a study of the infrared absorption line intensities of simple molecules. The other was a high resolution effort in the vacuum ultraviolet from which values of the spectroscopic constants to a quite high precision were obtained for the nitrogen molecule. The junction of these programs has resulted in the extension of the electronic spectrum of molecular nitrogen well into the infrared and in the generation of a considerable body of tabular data bearing on the intensity of the various emission features of nitrogen in all spectral regions. The results should be of interest to those working on various types of discharges in air, nitrogen, or any other mix which is not vigorously uncontaminated. In particular, the conclusions have a clear bearing on relative intensities in the aurora and the emphasis in much of the discussion is from that point of view. Author (TAB)

N69-16194 Princeton Univ., N. J.
BOUNDS IN SCATTERING THEORY
Porter Wear Johnson (Ph.D. Thesis) 1967 126 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-8931

Scattering is considered from central potentials of the form $v(r) = \int_0^\infty d\alpha\, m(\alpha) e^{-\alpha r^2 + r_0 r}$. It is proved that with certain conditions upon σ, the scattering amplitude corresponding to such potentials exhibits Orear behavior. It is also shown that for a certain subclass of these potentials the scattering amplitude converges to its first Born term at high energies for a fixed angle of scattering. A speculation is made about Orear behavior being exhibited for certain more general class of potentials than the above. Partial wave dispersion relations are solved with a given left hand cut discontinuity through the aid of unitarity. Dissert. Abstr.

N69-16222 Pennsylvania Univ., Philadelphia.
THEORY OF ELECTROMAGNETIC INTERACTIONS IN H_2 AND LiH
John Gruninger (Ph.D. Thesis) 1967 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-9202

The nuclear shielding constants of lithium hydride and the hydrogen molecule are calculated theoretically, by the gauge invariant atomic orbital (GIAO) method. The effect of an electric field E on the shielding constants of the protons of H_2 is considered. The component of the electric field along the internuclear axis causes a linear effect on the shielding constants. A simplified method for obtaining shielding constants is proposed. In the approximate calculation contributions of the excited states to the nuclear shielding are neglected. With the exception of the shielding constants of the lithium nucleus, the agreements of the complete calculations and the approximate calculations with the experimental values are good. Possible sources of error and means of improving the GIAO method are discussed. Dissert. Abstr.

N69-16229 Pennsylvania State Univ., University Park.
AN ELECTRON PARAMAGNETIC RESONANCE INVESTIGATION OF SOME GROUND STATE TRIPLET MOLECULES
Richard Joseph Kempe (Ph.D. Thesis) 1967 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-8707

The present study involved the evaluation of the zero field splitting parameters D and E, and the g-factors for a series of odd alternant methylenes consisting of propargylene and some of its homologs in randomly oriented samples. By observing the EPR spectra of these triplet compounds at two different frequencies, D and E as well as the g-factors of the molecules can be evaluated. The observation of the EPR spectrum of triplet CH_2 was also attempted, since if the spin orbit interaction is involved at all in the zero field splitting of the ground state methylenes, it would possibly make a large contribution in the methylene fragment where various one center integrals contribute to the spin orbit interaction energy. From the X-band P-band EPR spectra taken at low temperature, the g-factors were evaluated for the triplet alternant methylenes. Also studied was the effect of the matrix on the linewidths of the $\Delta m = 1$ resonances as well as the substituent effects on the zero field splitting in diphenyl methlyene. Dissert. Abstr.

N69-16264# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABSOLUTE CROSS SECTIONS OF THE EXCITATION OF LEVELS OF ALKALI METAL ATOMS BY LOW ENERGY ELECTRONS
I. P. Zapesochnyy 14 Dec. 1967 13 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur (Moscow), v. 5, no. 1, 1967 p 7–13
(AD-678620; FTD-HT-23-1183-67) Avail: CFSTI CSCL 7/4

The effective cross sections of the excitation of the lower levels of sodium, potassium, rubidium and cesium atoms by collisions with 0-30 eV electrons were measured. Two maxima were found for the resonance levels, one of them being directly at the excitation threshold. It was shown that an extremely sharp drop in the excitation cross sections as n increases is characteristic for the levels of the principal series. The role of cascade transitions during electron excitation of the (2)S-, (2)P- and (2)D- levels was studied in detail. The dependance of the maximal excitation cross sections of the (2)S- and (2)D- levels upon the principal quantum number and the atomic number was established and its analytical form was found. The excitation cross sections of lithium atoms were predicted. The obtained experimental results were compared with the theoretical data. Author (TAB)

N69-16292# Oak Ridge National Lab., Tenn.
HIGH ENERGY MUON TRANSPORT AND THE MUON BACKSTOP FOR A 200 GeV PROTON ACCELERATOR

R. G. Alsmiller, Jr., M. Leimdorfer (Ind.-Matematik AB, Stockholm), and J. Barish Nov. 1968 35 p refs
(Contract W-7405-ENG-26)
(ORNL-4322) Avail: CFSTI

High-energy muon transport calculations are presented, and the shape of the muon backstop required for a 200-GeV proton accelerator is determined. Results obtained using several different transport approximations are given and compared. Author (NSA)

N69-16300# Oak Ridge National Lab., Tenn.
FLOTSAM—A TWO PARAMETER ON-LINE DATA ACQUISITION PROGRAM FOR THE PDP-7
A. L. Marusak (Tenn. Univ.) Oct. 1968 107 p refs
(Contract W-7405-ENG-26)
(ORNL-4299) Avail: CFSTI

FLOTSAM is a program for the PDP-7, designed to accept one- and/or two-parameter data from experiments. The two-parameter program used for measuring neutron cross sections by the time-of-flight technique from (d,n), (n,n'), and (p,n) reactions is described. A bank of six scalers can be read into the computer and stored. A continuous oscilloscope display of all or some of the data is provided, with three modes (linear, log, square root) available for the y-coordinate (number of counts in a channel). Light pen routines are provided to enable one to extract peak information from either old data stored on magnetic tape or from data as they are taken. Permanent storage of data is on IBM-compatible magnetic tape; the data can also be typed out or plotted on a CALCOMP plotter. A general description of the program, operating instructions, some flow charts, and the complete annotated listing of the program itself are presented. Author (NSA)

N69-16320# Stanford Linear Accelerator Center, Calif.
RESONANCES (THEORY)
Haim Harari Sep. 1968 77 p refs Presented at 14th Intern. Conf. on High Energy Phys., Vienna, 28 Aug.–5 Sep. 1968 Supported in part by AEC
(SU-SLAC-PUB-508) Avail: CFSTI

Two main theoretical topics related to the interpretation of resonant states are discussed. These are the present status of various hadron classification schemes and the role played by resonance states in the present understanding of strong interaction dynamics. The topics discussed include various theoretical models for meson spectroscopy including the quark model Regge theory, SU(3), and chiral SU(2) × SU(2). The baryon spectrum is treated with an emphasis on SU(3) and the quark model. The general question of the relation between t-channel Regge trajectories and s-channel resonances is considered. Possible mechaniams which may lead to loops in the Argand diagram for partial wave amplitudes are discussed. The speculative picture according to which most of the observed hadron reactions may be described in terms of sums of resonance excitations is also discussed. NSA

N69-16359 California Univ., Los Angeles.
CALCULATION OF ASYMPTOTIC DIFFUSION LENGTHS IN AN INFINITE HETEROGENEOUS LATTICE BY TRANSPORT THEORY
Robert Monroe Webb (Ph.D. Thesis) 1967 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-7493

The lattice diffusion lengths in the two principal directions of an infinite, heterogeneous, slab lattice are each derived by a transport theory method. The different definitions of the lattice diffusion length are stated and the reasons for the selection of the asymptotic relaxation length for this work are presented. The lattice is assumed to be nonmultiplying and the one velocity problem is considered. For the one dimensional problem, that is the principal direction perpendicular to the interfaces between slabs, Case's method of singular eigenfunction expansion of the transport equation is used. For the two dimensional problem of obtaining the lattice diffusion length in the direction parallel to the interfaces between slabs, the P_3 spherical harmonics approximation is used. The problem of excess boundary conditions arising from the multidimensional spherical harmonics approximation is discussed. It is shown that excess boundary conditions cannot arise from the symmetry boundary condition but will arise from the continuity condition. Dissert. Abstr.

N69-16375# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENERGY DISTRIBUTION AND DOSE RATE OF γ-QUANTA SCATTERED AT THE EARTH-ATMOSPHERE BOUNDARY
Yu. I. Kolevatov et al 1 Apr. 1968 18 p refs Transl. into ENGLISH from Vopr. Fiz. Zashch. Reaktorov, Sb. Statei (Moscow), no. 2, 1966 p 216–225
(AD-679376; FTD-HT-23-1552-67) Avail: CFSTI CSCL 20/8

The authors study the angular energy distribution of scattered gamma-radiation from an isotropic point source (Co60) at source-to-detector distances of 50 and 30 m and heights above ground level of 2-53 m. A method is proposed for determining the scattering field of gamma-radiation close to the boundary between two media based on an analysis of the results of this work and a comparison with the data in the literature. Author (TAB)

N69-16401# Tokyo Univ. of Education (Japan). Dept. of Physics.
LOW LYING STATES OF Be-9 STUDIED BY THE Li-7 (He-3,p)-9 Be REACTION
J. Sanada, Y. C. Liu, Y. Sugiyama, and O. Mikoshiba Sep. 1968 33 p refs
(TUENS-3) Avail: CFSTI

The energy spectrum and angular distribution of protons from $^{7}Li(^{3}He,p)^{9}Be$ reaction were measured at 2.20, 2.60, 3.00 and 3.20 MeV incident energies. Proton groups corresponding to the ground, 1.67, 2.43, 3.04 and 4.70 MeV states of ^{9}Be were observed. Differential Cross sections of each group in the angular range from 20° to 160° in the laboratory system were converted into those of the center of mass system and fitted with Legendre polynomials. Integrated cross sections over 0° to 180° were examined with the (2I+1) rule. The results show that the spin I = 1/2 is probable for the 3.04 MeV state. Author

N69-16420# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
SU(3) OR SU(2) BY SU(2): K SUB l3 FORM FACTORS AS A SYMMETRY PROBE
M. K. Gaillard Nov. 1968 24 p refs
(TH-68/36) Avail: CFSTI

K_{l3} form factors are studied, assuming SU(3) by SU(3) current commutation relations and pion pole dominance of the axial current divergence for small momentum transfer. A correction to the Callan-Treiman relation is derived, which is small in the limit of near SU(2) by SU(2) invariance and large and negative in the limit of near SU(3) invariance. In the latter limit, the corrected result conforms to the requirements of small leakage for SU(3) generators and predicts a negative value for the parameter c. Author

N69-16431# Maryland Univ., College Park. Dept. of Physics and Astronomy.
HYPERON LEPTONIC DECAYS

B. Sechi-Zorn Jun. 1968 11 p Presented at the Meeting of the Am. Phys. Soc., Washington, D. C.
(Contract AT(40-1)-2504)
(ORO-2504-122; CONF-680439-3; TR-839) Avail: CFSTI

New experimental data on hyperon leptonic decay are reviewed and discussed in the framework of the universal V–A Fermi interaction modified by the Cabibbo theory. NSA

N69-16448# Syracuse Univ., N. Y. Dept. of Physics.
THEORY OF THE SCATTERING OPERATOR I
F. Rohrlich [1968] 40 p refs Supported in part by NSF
Avail: Issuing Activity

The theory developed in this paper is physically an S-matrix theory but mathematically a (non-Langrangian) quantum field theory. It is related to the Lehmann–Symanzik–Zimmermann approach but does not involve an asymptotic condition, since it does not involve an interpolating field. Using only the asymptotic free fields and assumptions on unitarity and causality, an equation is derived for the S-operator whose solutions are both unitary and causal. An operator in this equation which is partly arbitrary indicates the freedom left for specifying the interaction. The theory does not involve renormalizations unless more than one interaction is involved and certain approximations are made. The solution of the S-operator equation can be accomplished in perturbation expansion as will be shown in a subsequent publication. Author

N69-16449# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
NON OSCILLATION AT HIGH ENERGY FROM A WELL DEFINED BEHAVIOUR OF THE PHASE FOR TWO-BODY SCATTERING AMPLITUDES
J.-L. Gervais Nov. 1968 6 p refs
(TH-88/39) Avail: CFSTI

It is proved that the criterion of non oscillation introduced by F. J. Yndurain and the author, is satisfied if the phases of the amplitude on the cuts have a limit at high energy. Author

N69-16454# Tokyo Univ. of Education (Japan). Dept. of Physics.
A REFINEMENT OF THE (2I PLUS 1) RULE
Y. Takeuchi and J. Sanada Oct. 1968 13 p refs
(TUENS-4) Avail: CFSTI

In the (d, α) reaction it was recognized experimentally and theoretically the (2I+1) line did not pass through the origin, where I is the spin of the final nucleus. We have extended the consideration to the general case and found that the (2I+1) line does not pass through the origin if $I \geq l$, where l is the spin of the emitted particle. Examples of the application of this refined statement are discussed. Author

N69-16538*# Gulf General Atomic, San Diego, Calif.
COLLISIONS OF ELECTRONS AND IONS WITH HYDROGEN ATOMS Final Report, 8 May 1967–7 May 1968
J. William McGowan 7 May 1968 85 p refs
(Contract NAS5-11025)
(NASA-CR-99265; GA-8705) Avail: CFSTI CSCL 20H

A study of 2p excitation of the hydrogen atom under electron impact is reported. The major finds have been the resonance structure just above the threshold of excitation, which was not predicted, and just below the threshold of $n = 3$, which was predicted but which for higher angular momentum states does not agree with theory. Resonance structure above $n = 3$ has also been observed. Dissociative excitation of H_2 and D_2 has been studied under high electron energy resolution. Several new dissociation channels have been identified. Gaseous filtering techniques to be applied to radiations in the vacuum ultraviolet were studied. Some of the computer codes used on this program are given in the report, along with abstracts and papers published this year. Author

N69-16596# Tennessee Univ., Knoxville.
EFFECTIVE NUCLEON-NUCLEON INTERACTIONS AND THE MICROSCOPIC DESCRIPTION OF NUCLEON-NUCLEUS SCATTERING
William Gary Love (Ph.D. Thesis) Dec. 1968 134 p refs
(TID-24733) Avail: CFSTI

A microscopic description is given of the inelastic scattering of nucleons from nuclei. Of particular interest in this work are those low-lying levels in nuclei near closed shells. More specifically, an effective nucleon-nucleon interaction, t_{eff}, is sought which, when used in the distorted-wave approximation, yields the correct transition amplitudes between two nuclear states of the above type. Since at very high energies the impulse approximation should be valid, it is used as a guide at the energies with which this work is concerned (e.g., $E \leq 150$ MeV). For all energies in this range the impulse approximation is found to be too weak when a simple shell model description of the nuclear states is used. For example, near 20 MeV it is found to predict less than 10 percent of the observed cross section. To investigate t_{eff} and consequently its departure from the impulse approximation, attention is focused on two principal aspects of the problem: the inclusion of core polarization effects, and the inclusion of exchange or knock-out terms in the transition amplitudes. Author (NSA)

N69-16646# Washington Univ., Seattle.
SPIN WAVE INTERACTIONS AND THE LOW TEMPERATURE BEHAVIOR OF THE HEISENBERG FERROMAGNET
William Morse Shaw (Ph.D. Thesis) Aug. 1968 261 p refs
(Contract AT(45-1)-1388)
(RLO-1388-540) Avail: CFSTI

An investigation was made of spin wave interactions and their effects upon low-temperature properties of the spin-1/2 Heisenberg ferromagnet. In a new technique, boson creation and annihilation operators are combined with projection operators to produce the spin operators associated with each site. These spin operators are then used to construct a Hamiltonian which treats as a vacancy any site with two or more spin deviations. In this investigation, the thermodynamic Green's function formalism of Martin and Schwinger is used along with a T-matrix approximation for the Green's functions. This formulation is used to investigate two spin-wave interactions and their contributions to the low-temperature free energy and magnetization. Examination of two spin-wave interactions at $T = 0°K$ yields exact expressions for the T matrix, scattering amplitude, and differential cross section. Author (NSA)

N69-16653 Illinois Univ., Urbana.
CROSS SECTIONS FOR POSITIVE PIONS, NEGATIVE PIONS, POSITIVE KAONS, AND NEGATIVE KAONS ON COMPLEX NUCLEI
William Verne Hassenzahl (Ph.D. Thesis) 1967 147 p
Avail: Univ. Microfilms. HC $7.00/Microfilm $3.00 Order No. 68-8102

A measurement of the absorption and diffraction cross sections of 3.5 GeV/c π and K mesons on beryllium, carbon, aluminum, copper and lead was made. A set of circular scintillation counters measured transmission as a function of angle for each element. Cross sections were then calculated from the observed transmissions. Absorption and diffraction cross sections are given for 3.5 GeV/c π^+, π^-, K^+ and K^- on beryllium, carbon and aluminum, for π^+, π^- and K^+ for copper, and for π^+ and π^- on lead. The diffraction cross sections are found to be larger than the

values predicted by optical model calculations. This is discussed in terms of the relative magnitudes of the real and imaginary parts of the nuclear potential. Dissert. Abstr.

N69-16658 Illinois Univ., Urbana.
THE RELATIVISTIC SCHROEDINGER EQUATION AND ITS APPLICATION TO PSEUDOSCALAR MESON BARYON SCATTERING IN A BROKEN SU(3) SYMMETRY MODEL
Jose Katz-Masson (Ph.D. Thesis) 1967 264 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 68-8131

The problem of pseudoscalar meson baryon scattering is discussed within the framework of the relativistic Schrödinger equation and in the four lowest partial waves. The driving force (potential) is obtained by calculating the allowed single particle exchange processes for which the exchanged particles have spin less than or equal to 3/2. The on shell potential is obtained using Feynman's rules with coupling constants assumed to be related by SU(3), and actual experimental masses are used for both the exchanged and incoming or outgoing particles. The potential is then extrapolated off shell and the coupled system of linear integral equations for the scattering amplitude is solved numerically. In some of the cases under consideration the potential is such that a non-Fredholm system of integral equations is obtained. In these cases a cutoff is introduced to convert them into a Fredholm system which can then be solved numerically. Dissert. Abstr.

N69-16781# Air Force Cambridge Research Labs., Bedford, Mass.
THE TWIN-EFFECT AND THE RED-SHIFT
E. J. Post Oct. 1968 22 p
(AD-678889; AFCRL-68-0507) Avail: CFSTI CSCL 20/10

The asymptotic relationship between twin-effect and acceleration red-shift is discussed from a point of view of theory and experiment. The paradoxical aspects of the twin effect can be reduced to two major factors: (1) the detour paradox, which means that the world-line geodesic within the light cone gives a maximum path - hence detouring saves proper-time; (2) the assumption that proper-time is a characteristic measure for biological aging. A number of physical aging phenomena are then reviewed. Accepting the physical reality of the twin-effect of proper-time, one can then delineate two contributions to this effect. (1) the kinematical effect associated with uniform translational motion, and (2) the acceleration effect related to the red-shift. The measurement of the acceleration red-shift by Hay et al (1960) may be considered as an unambiguous confirmation of the twin-effect in which primarily the red-shift contributes. No comparable check on the kinematical component is as yet available. In fact, experimentally it is not feasible to isolate the latter contribution. Author (TAB)

N69-16828*# Gulf General Atomic, San Diego, Calif.
NEUTRON CAPTURE CROSS SECTIONS OF TUNGSTEN AND RHENIUM Annual Summary Report
W. M. Lopez, M. P. Fricke, D. G. Costello, and S. J. Friesenhahn 30 Sep. 1968 101 p refs
(Contract NAS3-11188)
(NASA-CR-72474; GA-8835) Avail: CFSTI CSCL 20H

Neutron capture cross sections for natural tungsten and rhenium were measured from 1 to 700 keV energy using the time-of-flight technique. The neutron flux spectrum was monitored with ^{3}He proportional counters that were calibrated against measurements based on the ^{10}B(n,α)^{7}Li cross section below 80 keV and on the n+p scattering cross section at higher energies. New data were also obtained for the reactions ^{3}He(n,p)T and ^{10}B(n,α)^{7}Li. The measured energy variation of the capture cross sections above 80 keV relies solely upon the n+p cross section and differs significantly from previous data based on other standard neutron cross sections. Author

N69-16867 Michigan Univ., Ann Arbor.
S- AND P-WAVE PION PION PHASE SHIFTS AT LOW ENERGIES
Bryan Frank Gore (Ph.D. Thesis) 1967 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-7614

An inverse amplitude calculation is performed assuming analyticity, elastic unitarity, and approximate crossing symmetry. Seven parameters are introduced into the calculation. Five of these are fixed by crossing symmetry and two by requiring a p-wave resonance of mass 753 MeV with a width of 110 MeV. Computations are iterated by computer. Five parameterizations are investigated and eight solutions are found belonging to three of them. Only one solution is acceptable due to the presence of poles of the amplitude on the physical sheet. Both s-wave phase shifts drop from threshold. The decrease of these phase shifts at the ρ mass is 65° for I = 0 and 40° for I = 2. The p-wave phase shift is similar to the usual resonant behavior but does not approach 180° as rapidly. Scattering lengths are also given. Dissert. Abstr.

N69-17015# Windsor Univ. (Ontario). Dept. of Physics.
THE TRAPPING AND QUENCHING OF POTASSIUM RESONANCE RADIATION
G. Copley and L. Krause Nov. 1968 24 p refs
(Contract N00014-67-C-0538; ARPA Order 125)
(AD-679184) Avail: CFSTI CSCL 7/5

The report describes the effects of imprisonment of resonance radiation in potassium vapor and of collisions between excited potassium atoms and N2, H2, HD and D2 molecules, on the measured lifetimes of the 4P singlet states. TAB

N69-17020# Princeton Univ., N. J. Elementary Particles Lab.
EXPERIMENTAL STUDY OF SOME RADIATIVE DECAY MODES OF THE L_S AND K_S MESONS Technical Report, Apr. 1967-Oct. 1968
James E. Pilcher (Ph.D. Thesis) Oct. 1968 142 p refs
(Contract N00014-67-A-0151)
(AD-679190; TR-U9) Avail: CFSTI CSCL 20/8

A study of radiative decays of the neutral K mesons yielded the following limits with 90% confidence R(K(s) to 2 gamma rays)/R(K(s) to all) < 1.2%, R(K(L) to pos. pion + neg. pion + gamma)/R(K(L) to all) < 0.0056, and R(K(L) to neut. pion + 2 gammas)/R(K(L) to all) < 0.00023. The branching ratio R(K(L) to 2 gammas)/R(K(L) to all) is found to be (5.0 plus or minus 0.6) x 10-4, based on 115 events observed with negligible background. Author (TAB)

N69-17023# Princeton Univ., N. J. Elementary Particles Lab.
MEASUREMENT OF THE CP-VIOLATION PARAMETER THE ABSOLUTE VALUE OF ETA $_{00}$ IN K_L MESON DECAYS TO 2 NEUTRAL PIONS Technical Report, Mar. 1967-Oct. 1968
John K. Liu (Ph.D. Thesis) Oct. 1968 205 p refs
(Contract N00014-67-A-0151)
(AD-679189; TR-48) Avail: CFSTI CSCL 20/8

The CP-violating decay mode K (sub L) meson decays to 2 neutral pions, has been studied in a spark-chamber experiment at the Princeton-Pennsylvania Accelerator. The transverse-momentum spectrum of gamma-rays observed in a spectrometer was used to separate K (sub L) meson decays to 2 neutral pions, events from

the dominant K (sub L) meson decays to 3 pions events from the dominant K (sub L) meson decays to 3 pions decay modes, and these events were then reconstructed kinematically in the K sub L center of mass. Results are given. Author (TAB)

N69-17032*# National Aeronautics and Space Administration, Washington, D. C.
THE BEHAVIOR OF AN ELECTRON IN A HOMOGENEOUS ELECTRIC FIELD ACCORDING TO THE RELATIVISTIC THEORY OF DIRAC [UEBER DAS VERHALTEN EINES ELEKTRONS IM HOMOGENEN ELEKTRISCHEN FELD NACH DER RELATIVISTISCHEN THEORIE DIRACS]
Fritz Sauter Jan. 1969 23 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 69, 1931 p 742–764
(NASA-TT-F-12030) Avail: CFSTI CSCL 20H

Solutions to the Dirac equation are given for the potential V = vx, and their relations discussed. On the behavior of the functions, which appear in their nonrelativistic form, an area appears in the Dirac solutions where momentum and velocity of an electron have opposite signs. The probability of an electron leaving the area of positive momentum and entering an area of negative momentum is studied. It appears at first sight that the probability of transmission takes on an infinite value if the potential rise over an interval comparable with the Compton wavelength is approximately equal to the rest energy of the electron. Klein's values for the transmission probability through a potential jump of the order of magnitude of the doubled rest energy should be considered as limiting values in the case of an infinite potential gradient. Author

N69-17046# California Univ., Berkeley. Lawrence Radiation Lab.
PION EXPERIMENTS
Kenneth Crowe *In* Los Alamos Sci. Lab. 1st LAMPF Users' Meeting Sep. 1968 p 29–31 refs (See N69-17041 06-11)
Avail: CFSTI

Pion experiments of interest to meson factories are suggested, emphasizing that the main feature of the pion, its strong coupling to nucleons, can be studied with beams of lesser intensity than those found at these facilities. The main area of experimentation, therefore, lies in the area of rare decays, unlikely reactions, or much high precision in the current processes. Included are experiments with weak interactions involving the rare modes of π^+ and π^- decay, and time reversal violation, in addition to the well worked investigations of nuclear structure, elastic and inelastic scattering, $\Delta T_z = \pm 2$ reactions and pionic X-rays. A.C.R.

N69-17048# Los Alamos Scientific Lab., N. Mex.
PROTON EXPERIMENTS AT LASL
George J. Igo *In its* 1st LAMPF Users' Meeting Sep. 1968 p 41–56 refs (See N69-17041 06-11)
Avail: CFSTI

The potential role of the Los Alamos Meson Physics Facility in nuclear physics research during the 1970's is discussed. High resolution experiments with proton beams up to 800 MeV, moderate resolution experiments with pions up to 400 MeV, and high resolution electron scattering investigations will allow the study of a nuclear state using three different high energy projectiles. A project to develop a high resolution spectrometer facility for use with proton beams is discussed in detail. Research possibilities with this facility lie in the field of nuclear spectroscopy and in the study of nucleon correlations in nuclei. Plans of user groups from several research facilities and universities for utilizing these facilities are outlined. The experimental arrangement in the proton area is also described. A.C.R.

N69-17069# Windsor Univ. (Ontario). Dept. of Physics.
AN ISOTOPE EFFECT ON 6 SUP 2 P SUB 1/2–6 SUP 2 P SUB 3/2 MIXING IN CESIUM, INDUCED IN COLLISIONS WITH CH SUB 4 AND CD SUB 4 Interim Report
D. A. McGillis and L. Krause Nov. 1968 10 p refs
(Contract N00014-67-C-0538; ARPA Order 125)
(AD-679188) Avail: CFSTI CSCL 7/4

The 6P(1/2) – 6P(3/2) singlet excitation transfer in cesium, induced in collisions with CH4 and CD4 molecules, has been studied in relation to the temperature of the vapor-gas mixtures. The variation with temperature of the cross section ratio Q(CH4)/Q(CD4) is ascribed to an isotope effect which is interpreted on the basis of the theory of absolute reaction rates. Author (TAB)

N69-17108# Paris Univ., Orsay (France). Lab. of Theoretical Physics and High Energies.
REGGE POLES AND POLARIZATION IN NEGATIVE KAON PROTON ELASTIC SCATTERING
Guy Plaut Sep. 1968 17 p refs
(LPTHE-TH-68/30) Avail: CFSTI

A five Regge pole is presented and used to fit polarization data in K⁻p elastic scattering between 2 and 2.4 GeV/c. Following a phenomenological analysis, solutions are obtained consistent with high energy data and sample predictions are given for polarization in other KN scattering experiments. Author (NSA)

N69-17129# Los Alamos Scientific Lab., N. Mex.
BIBLIOGRAPHY OF INTERACTIONS OF NUCLEONS WITH NUCLEONS IN THE ENERGY RANGE 100 Ke V TO 1 Ge V
Jean Furnish 26 Sep. 1968 81 p refs
(Contract W-7405-ENG-36)
(LA-4002-MS) Avail: CFSTI

A search of Nuclear Science Abstracts from Volume 20 (1966) through Volume 22, Number 12 (June 30, 1968) was made for information on the following types of interactions: neutrons with neutrons, neutrons with protons, and protons with protons. In general the energy range was limited to 100 keV to 1 GeV, and theoretical as well as experimental papers have been included. The abstracts are arranged in numerical order within each volume of NSA with the abstracts from the most recent volume placed first. (NSA)

N69-17130# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.
IMPROVED DESCRIPTION OF PARTICLE PRODUCTION BY THE THERMODYNAMIC MODEL
J. Ranft Jun. 1968 13 p refs
(RHEL/R-165) Avail: CFSTI

A better fit is obtained for the momentum spectra of π^-, K⁻ and $\bar{p}$, produced in proton-proton collisions according to the thermodynamic model, by including the contribution to the π^--spectra which results from two-body decay of through-going isobars. Preliminary studies also indicated how to change the spectral formulas, within the framework of the model, in such a way as to remove the former disagreement with measurements carried out at 12.5 GeV/c primary protons momentum and small longitudinal secondary momentum. Author (NSA)

N69-17134# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
A DERIVATION OF UPPER BOUNDS FOR FORWARD AND FIXED MOMENTUM TRANSFER SCATTERING AMPLITUDES AT HIGH ENERGIES
K. Chadan Jul. 1968 8 p refs
(TH-68/23; IPNO/LA-68/23) Avail: CFSTI

A simple derivation of high energy upper bounds for forward and nearly forward (fixed momentum transfer) scattering amplitudes which satisfy the analyticity properties of axiomatic quantum field theory is given using continuous variables. The case of neutral scalar particles of equal mass in considered. NSA

N69-17137# Paris Univ., Orsay (France). Lab. of Theoretical Physics and High Energies.

ASYMPTOTIC BEHAVIOR OF THE NUMBER OF BOUND STATES OF A GIVEN POTENTIAL IN THE LIMIT OF LARGE COUPLING

K. Chadan Jun. 1967 16 p refs

(LPTHE-TH-68/16) Avail: CFSTI

Given a potential V(r), which is assumed to be everywhere positive, nonincreasing as r increases, and for which $\int_0^\infty \sqrt{V(r)}\, dr < \infty$, it is shown that the number of bound states of g V(r) in any angular momentum state l has the asymptotic behavior $n_l(g) \sim \pi^{-1} \int_0^\infty \sqrt{V(r)}\, dr \sqrt{-g}$ in the limit $g \to -\infty$. On the basis of several examples, it seems that the above theorem is valid even if V(r) is only positive, without being everywhere nonincreasing. Author (NSA)

N69-17142# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

EXACT DETERMINATION OF THE COULOMB AMPLITUDE BY S-MATRIX METHODS

X. Artru, M. Fontannaz, and R. Omnes Jul. 1968 40 p refs

(TH-68/19; IPNO/LA-68/19) Avail: CFSTI

An extension of the S-matrix methods to the case of the exchange of zero-mass particles allows one to determine the Coulomb scattering amplitude and the levels of the hydrogen atom completely. One starts from the special analytic properties in t due to the zero mass of the photon, and writes the amplitude as an entire function of l n t. Two of the main assumptions are: the amplitude is of exponential type with respect to ln t; and the partial wave amplitude has only Regge poles in l. Several classes of solutions are found. One of them is the Schroedinger solution. The others lead to ghosts or to bound states in the e-p system and are therefore discarded. The same method can be extended to the nonrelativistic problem with spin and leads to the same result as in the case without spin. In the relativistic case, the results do not agree with the Dirac and Klein-Gordon solutions. Author (NSA)

N69-17144# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems

CAPTURE (NEGATIVE pi-MESONS) IN THE GAS MIXTURE OF HYDROGEN WITH DEUTERIUM

V. I. Petrukhin and Yu. D. Prokoshkin 1968 10 p refs In RUSSIAN

(JINR-P1-4036) Avail: CFSTI

The π^--meson transfer from the hydrogen to deuterium in the gas mixture $H_2 + D_2$ was investigated. The observed peculiarities of the capture can be explained within the framework of the phenomenological model. Author

N69-17145# Oak Ridge National Lab., Tenn. Computing Technology Center.

TRANSMISSION OF NEUTRONS THROUGH PLANE, PARALLEL, MULTILAYER SLABS

A. P. Suvorov et al [1968] 34 p refs Transl. into ENGLISH from Vopr. Fiz. Zashchity Reaktorov, Sb. Statei, Vypusk 2 (Moscow), 1966 p 22-34

(ORNL-tr-2021) Avail: CFSTI

A finite-difference method is proposed for a numerical solution of a one-dimensional kinetic equation describing the penetration of radiation through a material in terms of complex functions of energy, angles, and spatial coordinates. This method is based on the multigroup system of analysis and gives high accuracy while requiring a comparatively small amount of machine time. In solving the finite-difference system, the coefficients of transmission and reflection are calculated for a sequence of layers increasing in thickness and these coefficients are then used for finding the approximate values of radiation intensity. The method is used for analyzing the passage of radiation through a plane-parallel shield consisting of several layers. The proposed method for solving a multigroup system of equations is used as the basis for compilation of programs for calculating the characteristics of one-dimensional shielding.

N69-17151# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

THE STRUCTURE OF THE PROTON STATES FOR NUCLEI Mn 51, 53, 54, 55 and Co 55, 57, 59

V. V. Okorokov, V. M. Serezhin, V. A. Smotryaev, D. L. Tolchenkov, I. S. Trostin et al 1968 34 p refs In RUSSIAN

(ITEF-598) Avail: Issuing Activity

The proton states of the nuclei ^{51,53,54,55}Mn and ^{55,57,58}Co were investigated using (d,n) reactions. The neutron spectra were measured using the time-of-flight method. The values l_p and $(2j+1)C^2S$ for the resolved levels were obtained from a distorted-wave calculation. The spectra from (d,n) and (d,p) reactions on nuclei with identical shell filling were compared. Author (NSA)

N69-17163# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie.

ESTIMATION OF UNKNOWN EXCITATION FUNCTIONS FOR (α, xn), (α, pxn), (d,xn), (d,pxn), AND (p,xn) REACTIONS [ABSCHAETZUNG UNBEKANNTER ANREGUNSFUNKTIONEN FUER (α, xn)-, (α, pxn)-, (d,xn)-, (d,pxn)-, UND (p,xn)-REAKTIONEN]

Juergen Lange and Helmut Muenzel May 1968 36 p refs In GERMAN

(KFK-767) Avail: CFSTI

A procedure for constructing unknown excitation functions is outlined. A compilation of experimental data is presented, and constructed and experimental excitation functions for several mass regions are compared. NSA

N69-17164# Oak Ridge National Lab., Tenn.

MONTE CARLO CALCULATIONS (ORR) OF LOW-ENRICHED URANIUM THERMAL CRITICAL ASSEMBLIES, AND EVIDENCE OF ERRORS IN U-238 CROSS SECTIONS

J. Wallace Webster Nov. 1968 154 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-2187) Avail: CFSTI

As criticality calculation methods have become more exact and capable of utilizing cross sections in all their detail, instead of in the form of integral values such as age and resonance escape probability, evidence has been growing that the computed multiplication factors, k_{eff}, of low-enriched U thermal systems are low compared to experiment. This discrepancy occurs when the Monte Carlo method is used together with point-set representations of the cross sections. Considerable analysis was devoted to the representation of the ^{238}U cross sections with point sets of data and the results are presented by Calcomp plots of cross section vs neutron energy and tables of the resonance integrals. The critical experiments chosen for comparisons with computations were all unreflected, homogeneous, and representative of a broad range of resonance capture in ^{238}U. A definite pattern emerged from these comparisons; namely, the greater the neutron capture in

^{238}U, the lower the computed k_{eff}. The evidence of errors in the cross sections of ^{238}U or their representation, previously noted by others, is thus strengthened. Author (NSA)

N69-17165# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Problems.
COORDINATES AND OBSERVABLES IN THE NUCLEAR THREE-BODY PROBLEM
Yu. Niri and Ya. A. Smorodinskii 1968 32 p refs
(JINR-E4-4043) Avail: CFSTI

For a system of three particles, coordinates and operators of SU(3) representations on the six-dimensional sphere are constructed. A method for calculating harmonic functions is given. Two types of harmonic functions (K and B polynomials) are considered. Author (NSA)

N69-17168# Paris Univ., Orsay (France). Lab. of Theoretical Physics and High Energies
TIME DEPENDENCE OF PAIR CORRELATION IN FLUIDS IN TERMS OF SELF DIFFUSION AND STATIC STRUCTURE
Juhani Kurkijaervi Jul. 1968 7 p refs
(LPTHE-68/20) Avail: CFSTI

An attempt to describe the time dependence of the density-density correlation function of a simple fluid by a simple geometrical argument is presented. Results are compared with computer experiments. Author (NSA)

N69-17170# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'Noi Fiziki.
POLARIZATION EFFECTS IN DIRECT NUCLEAR REACTIONS WITH THE FORMATION OF THREE PARTICLES
V. M. Kolybasov 1968 24 p refs In RUSSIAN; ENGLISH Summary
(ITEF-605) Avail: CFSTI

Polarization phenomena are considered for the case in which the amplitude is dominated by pole graph. The polarization and the alignment of the residual nucleus, and the asymmetry in reactions on polarized targets, are expressed in terms of the polarization of the particles involved in the virtual two-body reaction. The results can be used for identification of the reaction mechanism and for determination of the residual nucleus spin. Author (NSA)

N69-17174# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
PERTURBATION THEORY OF MASSIVE YANG-MILLS FIELDS
M. Veltman (Utrecht State Univ.) Aug. 1968 22 p refs
(TH-68/28; IPNO/LA-68/28) Avail: CFSTI

Perturbation theory of massive Yang-Mills fields is investigated with the help of the Bell-Treiman transformation. Diagrams containing one closed loop are shown to be convergent if there are more than four external vector boson lines. The investigation presented does not exclude the possibility that the theory is renormalizable. Author (NSA)

N69-17183 College of William and Mary, Williamsburg, Va.
MEASUREMENTS OF 2p TO 1s LINE WIDTHS IN LOW-Z PIONIC ATOMS
Robert Joseph Harris, Jr. (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-8297

The natural line widths of 2p –1s transitions in low-Z pionic atoms were measured using high resolution lithium-drifted silicon and germanium detectors. High resolution was achieved by developing a low noise cooled FET preamplifier which allowed the inherently good resolving capability of Si(Li) and Ge(Li) detectors to be more fully exploited than was previously possible. The instrumental resolution as measured with muonic X-rays was 0.62 keV at 33 keV for the Si(Li) spectrometer, and 1.1 keV at 75 keV for the Ge(Li) spectrometer. Pionic atoms were formed by stopping negative pions in the following targets: Li^6, Li^7, Be^9, B^{10}, B^{11}, and C^{12}. Dissert. Abstr.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N69-16105*# State Univ. of New York, Stony Brook. Dept. of Electrical Sciences.
KINETIC THEORY FOR THE ATTENUATION OF WAVES IN PLASMAS
Hang-Sheng Tuan Oct. 1968 20 p
(Grant NGL-33-015-066)
(NASA-CR-99229) Avail: CFSTI CSCL 20I

Collision damping and Landau-type damping are two major loss mechanisms known for electromagnetic waves propagating in plasmas. When an accurate estimation of the attenuation of waves is desired, a simultaneous solution to plasma kinetic equation and Maxwell equations is required but very difficult to obtain. A simplified set of kinetic equations are introduced to replace the original so that simultaneous solutions for problems of wave propagation may be obtained without unsurmountable mathematic difficulty. Special cases of transverse and longitudinal propagations are analysed by using the system of equations to insure that both loss mechanisms are predicted by the new equations. Author

N69-16262# Royal Aircraft Establishment, Farnborough (England).
APPROXIMATE METHODS OF CALCULATION OF SEVERAL PLASMA PARAMETERS AND THE SPECIAL APPLICATION TO PLASMA FLOWS. PART 2: APPROXIMATE CALCULATIONS OF PLASMA EXPANSIONS IN LAVAL NOZZLES [NAERUNGSMETHODEN ZUR BESTIMMUNG ZAHLREICHER PLASMAPARAMETER UND DEREN SPEZIELLE ANWENDUNG AUF PLASMASTROEMUNGEN. TEIL 2: NAEHERUNGSBERECHUNGEN ZUR ENTSPANNUNG VAN PLASMEN IN LAVAL-DUESEN]
J. Artmann Sep. 1968 30 p refs Transl. into ENGLISH from German report DVL-68-36
(RAE-LIB-TRANS-1320; DVL-68-36) Avail: CFSTI

The conservation laws can easily be evaluated by the approximate method described in detail in Part I, if additional forces (gravity or electromagnetic forces) acting on steady plasma flow are disregarded and friction, heat conductivity and radiation are neglected. The calculations are particularly simple for certain limiting cases of expansion in Laval nozzles. The introduction of the approximate degree of dissociation or ionisation (x or x_i in Part I) simplifies the calculation for the limiting case of frozen flow (x or x_i = const), because the adiabatic equation for ideal gases applied in this case. It also greatly simplifies the calculation for the other limiting case of flow in thermical equilibrium (LTE). Heat addition during these two cases of expansion can easily be included for the limiting case of isothermal flow. These investigations are particularly important in describing flows in thermal plasma propulsion systems. The calculations for the four limiting cases have therefore been carried out for hydrogen- lithium- and argon-plasmas. Author

N69-16277 Illinois Univ., Urbana.
RECOMBINATION IN LOW TEMPERATURE HELIUM PLASMAS
James Peter Kaplafka (Ph.D. Thesis) 1967 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 No. 68-8130

A study was made of the afterglows of plasmas produced in pure helium gas at atomic densities $\approx 10^{18}$–10^{19}/cc. Qualitative observations were made at a gas temperature of 4.2 °K while most quantitative results were obtained at a gas temperature of 77 °K at a pressure of 9.5 Torr in a region of free electron densities 10^{8}–10^{11}/cc. Molecular band radiations from $n = 4$–2 and 3–2 transitions of the He_2 molecule were found to be the sole prominent contributions to the visible afterglow light intensity for times beyond ≈400 μsec of the afterglow. Measurements of free electron density, n_e, and total "effective" electron collision frequency for momentum transfer, ν_{eff}, were made with a low power sensing microwave signal transmitted through the afterglow plasma. The measured values of ν_{eff} were interpreted to give the temperatures of the free electrons gas. gas, T_e. Dissert. Abstr.

N69-16363# ARO, Inc., Arnold Air Force Station, Tenn.
NONINTERFERENCE VELOCITY MEASUREMENTS IN A SUPERSONIC SEEDED PLASMA USING TRACERS PRODUCED BY A SPARK DISCHARGE AND A FOCUSED PULSED LASER Final Report, Nov. 1966-Jul. 1968
J. C. Pigott and L. E. Rittenhouse Arnold Eng. Develop. Center Nov. 1968 48 p refs
(Contract F40600-69-C-0001)
(AD-678521; AEDC-TR-68-235) Avail: CFSTI CSCL 20/4

Experimental results are presented from a program conducted to develop a noninterference method for obtaining the velocity of a supersonic, high enthalpy plasma seeded with an alkali metal. The technique used was the time-of-flight measurement of a tracer spark produced in the plasma by an electric spark discharge (two pointed electrodes) and by a focused pulse laser. The tracer spark was photographed with a streak and framing camera or an image-converter camera at preselected delay times to obtain the time-of-flight velocity measurements. The experimental work was accomplished in air and nitrogen plasmas, at a static pressure of about 1 atm and at total enthalpies up to 2700 Btu/lb. Velocities were measured up to 2600 m/sec. The techniques used are described, and the problems and results are discussed. Author (TAB)

N69-16368 Kansas Univ., Lawrence.
ELECTROMAGNETIC WAVES IN MOVING MAGNETO-PLASMAS
Basant Ram Chawla 1967 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-6908

Various aspects of electromagnetic wave propagation in moving plasmas are considered. They are: characteristic equations for waves propagating in arbitrary direction in temperate and warm plasmas moving uniformly at an arbitrary angle to a uniform static magnetic field, radiation from electromagnetic sources in the presence of a uniformly moving temperate magnetoplasma, normal and oblique incidence of linearly polarized plane electromagnetic waves on a semi-infinite or slab of temperate or warm magnetoplasma moving through free space or a dielectric medium, radiation from an electric dipole in the presence of a moving dielectric half space, Poynting vector in moving plasmas, and wave propagation in a two stream magnetoplasma. The characteristic equation for the waves in a moving temperate plasma is found using two different models which give identical results. Dissert. Abstr.

N69-16391*# Space Sciences, Inc., Waltham, Mass.
THE STUDY OF PLASMA BOUNDARY INTERACTIONS Quarterly Report, 1 Mar.-31 May 1968
S. Aisenberg, P. Hu, V. Rohatgi, and S. Ziering May 1968 29 p refs
(Contract NASw-1703)
(NASA-CR-99245; SSI-455-QR3) Avail: CFSTI CSCL 20/

The arc velocity of a rotating plasma is determined experimentally using the back emf and the time of flight methods. The measurements are made for several electrode materials and gases over a wider range of arc parameters. These measurements indicate that the arc velocity is inversely proportional to the gas pressure which can be described by a power law relation. This is not in agreement with the ionization limiting velocity concept. Further the arc velocity is found to be independent of the magnetic field when determined by the back emf method whereas the time of flight method shows that the velocity increases with the increasing magnetic field. The dependence of arc velocity on the magnetic field, as obtained by the time of flight method, suggests that the measured threshold and the saturation effects in the electrode drag force cannot be explained in terms of the possible threshold and saturation effects in the plasma velocity. Author

N69-16413# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF PLASMOIDS (SELECTED ARTICLES)
12 Sep. 1967 57 p refs Transl. into ENGLISH from Issled. Plazmennykh Sgustkov (Kharkov), 1965 p 89–102; 156–181
(AD-678694; FTD-HT-23-777-67) Avail: CFSTI CSCL 20/9

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3. OPERATION OF THE COAXIAL PLASMA SOURCE IN A LONGITUDINAL MAGNETIC FIELD I. M. Zolototrubov et al p 31–38 refs (See N69-16416 08-25)

4. INVESTIGATION OF A DISCHARGE IN A PULSED PLASMA SOURCE A. A. Kalmykov et al p 39–60 refs (See N69-16417 08-25)

N69-16414# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INSTABILITY DEVELOPMENT IN A PLASMOID INJECTED INTO AN AXIALLY SYMMETRICAL MAGNETIC FIELD
A. A. Kalmykov et al *In its* Invest. of Plasmoids (Selected Articles) 12 Sep. 1967 p 1–18 refs (See N69-16413 08-25)
Avail: CFSTI

Investigations with a coaxial plasma gun produced hydrogen plasmoids of density up to 10^{13} cm^{-3} and velocities (7–8) × 10^{7} cm/sec. The magnetic field was produced at a distance (100 cm) sufficient for attenuation of the currents captured by the plasmoid. Since the front part of the plasmoid lacked sufficient luminosity, its structure was investigated with a newly developed plasmascope, and the field distribution was measured with the aid of probes. The behavior of the plasmoids in the non-uniform magnetic field was very similar to that occurring during rapid compression of the plasma in a θ pinch, and the test results are interpreted in light of this phenomenon. Possible cause of the instability of the plasmoid upon entering the axially symmetrical field may be reflection of part of the electrons on entering the magnetic field and the development of a radial electric field. It was also noted that the injection can be accompanied by rotation of the plasma, which may hinder the injection of plasma in magnetic traps of either mirror or acute-angle geometry. Author

N69-16415# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POSSIBLE MECHANISM OF THE ORIGIN OF HIGH-ENERGY PARTICLES IN THE COAXIAL PLASMA GUN

A. D. Timofeyev et al *In its* Invest. of Plasmoids (Selected Articles) 12 Sep. 1967 p 19–30 refs (See N69-16413 06-25)
Avail: CFSTI

Mechanisms of production of high energy particles in a coaxial plasma gun were studied using a framing camera for observation of the plasma, a Rogowskiy coil for the measurement of current densities, and scintillation counters for X-ray detection. Analysis of the results shows that in those discharges where plasma formation alone was observed, the discharge remains symmetric. The symmetry is preserved with polarity change, as well as in the operating regime where fast particles are generated. In the case of unstable discharges, the X-ray detector registered copious hard X-rays. The instability leads to large changes of inductance which induce abrupt voltage changes on the electrodes. Time correlation of the voltage increase with X-ray emission indicates that the fast ions are generated by these instabilities. An analysis of the electrical circuit of the system with its time varying load shows that sufficiently large accelerating voltages can occur at plasma densities at which instabilities occur. Author

N69-16416# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OPERATION OF THE COAXIAL PLASMA SOURCE IN A LONGITUDINAL MAGNETIC FIELD

I. M. Zolototrubov et al *In its* Invest. of Plasmoids (Selected Articles) 12 Sep. 1967 p 31–38 refs (See N69-16413 06-25)
Avail: CFSTI

An attempt to develop a plasma source free of impurities by the use of a coaxial gun in a longitudinal magnetic field is discussed. The plasma gun and its operation is described: its energy source is a battery of condensers (1000 μf) working at 5 kV; the working gas is hydrogen injected by a fast acting valve. When the gun is operated in the magnetic field, the discharge current plate appears. This, together with the observation of the plasma ejection velocity, indicates plasma drift typical of crossed electric and magnetic fields. High speed photography reveals that the plasma generated when the magnetic field is applied is much more uniform than in the absence of the field. Spectroscopic analysis shows that the magnetic field inhibits very strongly the appearance of electrode material impurities found in discharges without the external field. It is planned to overcome the insufficient ionization and low plasma velocity by increasing the electric power input and the modified magnetic field. Author

N69-16417# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF A DISCHARGE IN A PULSED PLASMA SOURCE

A. A. Kalmykov et al *In its* Invest. of Plasmoids (Selected Articles) 12 Sep. 1967 p 39–50 refs (See N69-16413 06-25)
Avail: CFSTI

The performance, characteristics and structure of a plasma gun with a hot cathode are studied. The gun was operated with a pulsed magnetic field (20 μsec) during which a much shorter high voltage pulse was applied to the cathode and resulted in ejection of both ions and electrons. The collector received about one ampere of ion current during such pulsed operations. As in other guns, the ion acceleration occurred only during the first few tenths of a microsecond, and the energy reached often exceeded the applied accelerating voltage. It was noted that when artificial transmission lines were used for the energy storage, plasma ejection occurred at each reflection of the wave thus forming a long train of plasmoids. The plasma properties were studied with a mass spectrometer, X-ray detectors and high speed photography. The results for various pressure and current conditions are shown and analyzed in terms of the electric circuit interaction with a simple plasma model. Author

N69-16433# Aeronautical Research Associates of Princeton, Inc., N. J.

ON THE KINETIC THEORY OF PLASMA Final Report, 15 Jul. 1965–15 Jul. 1968

Arnold H. Kritz and Guido Sandri Wright-Patterson AFB, Ohio ARL Sep. 1968 106 p refs
(Contract AF 33(615)-1910)
(AD-678577; ARL-68-0136) Avail: CFSTI CSCL 20/9

In view of difficulties encountered in attempting to develop kinetic theory beyond the lowest-order results, it is of major interest to ascertain whether or not the Bogolubov expansion method is at fault or whether the complicated physics of three-body effects is the stumbling block. We have been able to show that Bogolubovs method fails for a model of kinetic theory with many of the features of the BBGKY hierarchy but lacking, by construction, three-body effects. The failure of Bogolubovs method can be traced without ambiguity in our model to a failure of the functional assumption in a certain region of phase space in the neighborhood of slow relative motion. A method that overcomes this difficulty has been developed and tested successfully with an explicitly soluble case. A kinetic description was developed, suitable to determine the transport properties of a plasma in the presence of moderately strong magnetic fields. For a Lorentz plasma the electron velocity distribution was calculated and the electron-electron contributions to electrical and thermal conductivities have been determined explicitly. A descriptive survey of solid-state plasma phenomena is given. We discuss the generation of solid-state plasmas, then waves, and instabilities in solid-state plasmas. Author (TAB)

N69-16466*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COMPONENTS OF A HYDROGEN PLASMA INCLUDING MINOR SPECIES

R. W. Patch Washington Jan. 1969 97 p refs
(NASA-TN-D-4993) Avail: CFSTI CSCL 20I

Tables and graphs of the number densities of hydrogen atoms (H), protons (H^+), free electrons (e^-), hydrogen molecules (H_2), negative hydrogen ions (H^-), hydrogen diatomic molecular ions (H^+_2), and hydrogen triatomic molecular ions (H^+_3) in a hydrogen gas or plasma in thermodynamic equilibrium were computed for temperatures from 300 to 40,000 K and pressures from 1.01325×10^5 to 1.01325×10^8 N/m^2 (1 to 1000 atm) except for a small, high density region. For temperatures above 2000 K, the Debye–Huckel approximation was employed. Morse potentials are given for all singly excited attractive states of H_2 with principal quantum numbers to 17. A FORTRAN IV computer program for computing number densities and other properties of a hydrogen plasma is included. Author

N69-16611# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OPTICAL INVESTIGATIONS OF THE AIR-PLASMA EXCITATION PROCESS IN ELECTROMAGNETIC SHOCK TUBES

L. S. Nikolayevskiy et al *In its* J. of Appl. Spectry. 17 Jan. 1969 p 1–8 refs (See N69-16610 06-34)
Avail: CFSTI

One shock tube in which the discharge is produced directly between electrodes, and three tubes in which the discharge is produced by induction were investigated. The direct excitation tube was described earlier, and the bulk of the tests were made on the

inductively coupled tubes, two of which used single exciting coils and one used two exciting coils. In all cases, a comprehensive study was made of the excitation and motion of the plasma in the tubes by using a high speed streak camera, a diffraction grating spectroscope, and a high speed spectrograph. All tests were made with air which was not subjected to special purification or drying, at initial pressures 1 to 2 mm Hg. The results show that the plasma front does not move uniformly, and its high velocity is the result of periodic jolts produced by plasmoids situated behind the plasma front. The plasma front is not flat, although the hypothesis that the excitation is produced by a shock front would call for a flat front. The spectral composition of the radiation, the plasma temperature, and the electron density near the exciting coil are the same for all tubes, the latter two being ≈ 35000K and ≈ 10^{17} to 10^{18} cm $^{-3}$.
Author

N69-16617# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCATTERED RADIATION SPECTRUM OF LASER AND MEASUREMENT OF ELECTRON CONCENTRATION IN PULSE PLASMA
V. P. Sidorov et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 41-46 refs (See N69-16610 06-34)
Avail: CFSTI

A giant pulse laser was used to study experimentally the scattered radiation spectrum and the electron concentration of a pulsed rf plasma. The plasma was generated by a rotating rf dipole (f = 2.45 MHz) with the aid of a system consisting of eight rods, parallel to the discharge tube (molybdenum glass, 100 mm long and 50 mm in diameter), which were excited by four rf oscillators with a spatial temporal shift of $\pi/2$. The quasi-constant magnetic field could be varied over a wide range. The dynamic measurements were made at initial hydrogen pressures of 2 × 10^{-2} mm Hg and at 150 oe rf and 5.5 koe magnetic field intensities. The 4 msec rf and the laser pulses were applied with an 0.5 and 1.5 msec relay with respect to the magnetic field. The resultant spectrum indicated high density plasma in the near axial region for which the Debye length is of the order of the laser wavelength. The electron temperature based on the Thompson line halfwidth was T_e = 4 ev.
Author

N69-16701# Oak Ridge National Lab., Tenn.
PROCEEDINGS OF INTERNATIONAL CONFERENCE ON PLASMA CONFINED IN OPEN-ENDED GEOMETRY
4 Nov. 1967 460 p refs Presented at the Intern. Conf. on Plasma Confined in Open-ended Geometry, Gatlinburg, Tenn., 1-4 Nov. 1967
(Contract W-7405-eng-26)
(CONF-671127) Avail: CFSTI

Conference papers are presented on the confinement of plasma in open-ended geometry, and the feasibility of using such open-ended systems as prospective containment devices for controlled fusion plasmas. For individual titles, see N69-16702 through N69-16720.

N69-16702# United Kingdom Atomic Energy Authority, Culham (England).
ION CYCLOTRON INSTABILITIES IN THE PHOENIX 2 EXPERIMENT
W. Calvert (ESSA, Boulder, Colo.), S. G. Cordey, G. Kuo-Petravic, E. G. Murphy, M. Petravic et al *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-Ended Geometry 4 Nov. 1967 p 1-26 refs (See N69-16701 06-25)
Avail: CFSTI

Recent results from the PHOENIX II neutral injection experiment are described. The plasma density achieved with magnetic well geometry is limited to about 5 × 10^{9} cm $^{-3}$ by an instability associated with the ion cyclotron frequency and its harmonics. The harmonic number increases with density and a complex line splitting is observed which may be associated with the axial oscillation frequency of the ions. Phase measurements indicate a half wavelength along the length of the plasma, and a much shorter azimuthal wavelength. Strong coupling to the parallel motion of the electrons is indicated by loop aerial signals and energetic electron ejection through the mirrors. The growth times can be less than a microsecond. At the highest densities some considerable spreading of the ion energy occurs.
Author (NSA)

N69-16703# California Univ., Livermore. Lawrence Radiation Lab.
THE ALICE EXPERIMENT
C. C. Damm, J. H. Foote, A. H. Futch, Jr., R. K. Goodman, F. J. Gordon et al *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 27-45 refs Sponsored by AEC (See N69-16701 06-25)
Avail: CFSTI

The Alice neutral-injection experiment employs a quadrupole magnetic-well containment field, formed by a coil in the shape of a baseball seam. Plasma densities as high as 5 × 10^{8}/cm^{3} were measured. Intermittent plasma oscillations were observed at densities above 10^{8}/cm^{3}. These oscillations are accompanied by anomalous loss of particles. Bursts of electrons and possibly energetic protons have been detected emerging through the mirror regions. In the presence of these losses the plasma density is limited to a value below that determined by charge exchange. At the highest density reached, the anomalous losses and charge-exchange losses are comparable. Introduction of a small energy spread into the otherwise monoenergetic, 15-keV injected beam was observed to increase the threshold density for onset of the plasma oscillations. In an effort to affect the instability mode or modes observed, and to obtain specific mode identification with theory, experiments designed to further broaden the energy distribution of the trapped protons and other experiments aimed at heating the plasma electrons with microwave radiation are underway.
Author (NSA)

N69-16704# Oak Ridge National Lab., Tenn.
PLASMA CONTAINMENT IN DCX 1.5
R. J. Colchin, J. L. Dunlap, and H. Postma *In its* Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 46-76 refs Sponsored by AEC (See N69-16701 06-25)
Avail: CFSTI

The DCX 1.5 device is a 20-keV H^{+} injection machine employing the magnetic field and vacuum tank of DCX 1. The neutral hydrogen beam is Lorentz ionized in a 2-1 mirror trap which has a maximum central field strength of 14 kG. The plasma diameter is 12 inches and its length (FWHM) is approximately 1.25 inches. Hot ion densities above 10^{8}/cm^{3} and lifetimes of 180 msecs have been attained. Three distinct and separable instability modes appear in DCX 1.5.
Author (NSA)

N69-16705# Oak Ridge National Lab., Tenn.
TARGET PLASMA EXPERIMENTS IN THE INTEREM FACILITY
M. C. Becker, C. W. Blue, R. A. Dandl, H. O. Eason, A. C. England et al *In its* Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 77-97 refs Sponsored by AEC (See N69-16701 06-25)
Avail: CFSTI

Experiments in the INTEREM facility are the first in a series in which energetic neutrals are to be injected and trapped through charge exchange with cold ions in a target plasma produced by resonant electron cyclotron heating. In the experiments in INTEREM, the target plasma is produced by application of 20 to 40 kW of 10.6-Gc microwave power. The electron density in such a plasma ranges from 5×10^{10} to 5×10^{11} electrons/cc, depending on the ambient pressure environment and applied power. In the main electron group, $T_e \sim 120$ keV. The cold electron density is approximately equal to the hot density. A beam current of 100 mA at 20 keV of H^+ is injected one Larmor radius off axis. The behavior as a function of injected current and pressure is in accord with "classical" behavior, i.e., charge exchange limited. The increased density observed in comparison with gas trapping is also as expected from the atomic cross sections. No instabilities are observed. Because of the short plasma length (approximately 0.5 cm), ion electron loss-cone type instabilities are not expected. However, no evidence of the "double-hump" gyrofrequency modes expected at the higher harmonics are seen. Author (NSA)

N69-16706# Oak Ridge National Lab., Tenn.
DCX-2 MICROINSTABILITY STUDIES
P. R. Bell (NASA, Manned Spacecraft Center, Houston, Tex.), J. F. Clarke, G. G. Kelley, N. H. Lazar, J. F. Lyon et al. *In its* Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 98–143 refs Sponsored by AEC (See N69-16701 06-25)
Avail: CFSTI

The injected H_2^+ beam was used to study the effect of finite length and electron temperature on the Burt–Harris instability. The dominant energetic proton plasma was suppressed, leaving only the cylindrical plasma shell formed by the spiralling ion beam and its associated cold plasma. Unstable traveling waves near harmonics of the ion cyclotron frequency were observed to propagate both parallel and antiparallel to the beam axial velocity component and in the direction of ion rotation. Although the calculations of Burt and Harris closely modelled the plasma geometry, the short wavelength modes predicted by them to be the most unstable were not observed. Electron Landau damping suppressed these instabilities, leaving longer wavelength modes which agreed with a recent modification of the Burt–Harris theory. The observed instability wavelengths were identified as axial normal modes of the plasma cylinder. The axial and azimuthal mode patterns of the beam-on instabilities in the energetic proton plasma have been measured in detail. The various harmonics have different axial mode patterns, indicating that they are separate instabilities and not a nonlinear manifestation of a single instability. Each mode forms a standing wave pattern which is either symmetric or antisymmetric about the machine midplane, implying reflections at the end of the mirror-confined hot plasma. NSA

N69-16707# Commissariat a l' Energie Atomique, Fontenay-aux-Roses (France).
PLASMA LOSSES IN THE MAGNETIC WELL OF DECA 2
P. Brossier, P. Lecoustey, C. Renaud, and J. Tachon. *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 144–169 refs (See N69-16701 06-25)
Avail: CFSTI

For a regime in which the magnetic well is partially established before the plasma injection and with a plasma density of 10^{10} cm^{-3}, a wave at the ion cyclotron frequency and its harmonics were observed. The azimuthal structure of modes warps along the flux tube. Where the lines of force converge, the phase of the wave turns faster than where they diverge. The small amplitude of fluctuations (the electric field is about 1 V/cm) probably would explain that one does not see any losses connected with the instability. On the other hand, it was established that the plasma is mainly lost by charge exchange with a neutral gas compounded of both atomic and molecular deuterium, the pressure of which is up to one hundred times the base pressure. The study of the main energy sources which can create the instability and the experimental observations could support the identification of the wave with a double distribution cyclotron instability. Author (NSA)

N69-16708# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
A CIRCULARIZED MAGNETIC WELL: DECA 2 B
J. P. Gaussorgues, P. Lecoustey, and J. Tachon. *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 170–174 (See N69-16701 06-25)
Avail: CFSTI

The lifetime of the plasma is presently limited, in DECA II, by the charge exchange phenomenon on a neutral gas mainly created by an outgassing of the walls when the injected plasma following the lines of forces impinges on the walls. Modifications to produce a circular magnetic well are briefly described. NSA

N69-16709# California Univ., Livermore. Lawrence Radiation Lab.
PLASMA CONTAINMENT IN THE 2X EXPERIMENT
F. H. Coensgen, W. F. Cummins, R. E. Ellis, F. R. Kovar, and W. E. Nexsen, Jr. *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 175–192 refs Sponsored by AEC (See N69-16701 06-25)
Avail: CFSTI

In the 2X experiment, plasma containment in open-ended systems is studied by rapidly creating a plasma then making time dependent measurement of density, ion energy, electron temperature, end losses, cross field transport, radiation, etc. Although low order interchange instabilities were suppressed in simple mirror systems by line-tying, higher order modes persisted so that it was impossible to evaluate the contribution of high frequency fluctuations to the observed anomalously rapid plasma loss. With conventional vacuum conditions (base pressure 5×10^{-7} torr) attempts to suppress the low frequency instabilities by transforming to a minimum-B containment field after the plasma was trapped encountered a very rapid plasma loss which was found to be associated with an influx of neutral gas. By reducing the base pressure to the 10^{-9} torr range and evaporating titanium throughout the entire chamber the neutral influx was reduced and at least one instability suppressed. Author (NSA)

N69-16710# California Univ., Livermore. Lawrence Radiation Lab.
ASTRON EXPERIMENTS
N. C. Christofilos. *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 193–195 Sponsored by AEC (See N69-16701 06-25)
Avail: CFSTI

Results of electron trapping experiments in the Astron will be presented. A beam of relativistic electrons 4 MeV at 300 A is injected in short pulses. The electrons are trapped in a magnetic field constant in time. The trapped electrons form an E-layer with a bell-shaped axial density distribution. The trapped current per cm to date is 25 A/cm, which is 6.4% of the level required to create a self-magnetic field of the E-layer equal and opposite of the confining magnetic field. At this time the achieved level of the E-layer is limited by the rate of injection of the electrons. Thus the combination of the E-layer with the external guiding field is still "open ended," which is a transitory state until an improved accelerator provides adequate injection rate to form an E-layer with closed magnetic lines. Author (NSA)

N69-16711# Princeton Univ., N. J. Plasma Physics Lab.
ION-CYCLOTRON INSTABILITIES IN MIRROR-CONFINED ENERGETIC PLASMA IN THE MODEL C STELLARATOR
I. G. Brown, M. A. Rothman, and R. M. Sinclair *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-Ended Geometry 4 Nov. 1967 p 196-214 refs (See N69-16701 06-25)
Avail: CFSTI

A portion of the plasma in the Model C stellarator is heated by ion cyclotron resonance heating and contained within magnetic mirrors (1.02 R 1.3). The plasma so formed (10^{12} to 10^{13} cm^{-3}) has little interaction with the main body of toroidal plasma, and has perpendicular ion temperature up to 4 keV while the electron temperature remains at less than 100 eV. The cooling of this energetic plasma (lasting several milliseconds) is accompanied by emission of radiation at frequencies close to the local ion cyclotron frequency and its harmonics. Experimental results are presented of observations of this rf activity, and related to theoretically predicted instabilities of the ion-cyclotron type. There is no correlation between the rf activity and the loss of particles or energy from the mirrors. The containment time seems limited by charge exchange. Author (NSA)

N69-16712# Commissariat a l'Energie Atomique, Saclay (France).
THE EFFECTS OF A HIGH FREQUENCY RESONANT FIELD ON THE PLASMA BEHAVIOUR IN MAGNETIC FIELD
T. Consoli *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 215-260 refs (See N69-16701 06-25)
Avail: CFSTI

Theoretical and experimental studies on the interaction of a stationary or progressive electromagnetic hf field with a plasma in a mirror-like magnetic field are in progress at Saclay. The aim of this research is the noncollisional energy transfer from the wave to the plasma, in view to get plasma acceleration and reflection. Descriptions are given for the following: (1) the features of the obtained beam and the measurements used for this proposal, (2) the acceleration of a laser-produced dense plasma puff, and (3) the effect of a pulsed mirror field on the acceleration beam. Author (NSA)

N69-16713# Commissariat a l'Energie Atomique, Saclay (France).
SELFCONSISTENT FIELD AND POWER ABSORPTION FROM ELECTRON CYCLOTRON RESONANCE IN A HIGH PLASMA ACCELERATOR
M. Brambilla *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 261-286 refs (See N69-16701 06-25)
Avail: CFSTI

Plasma acceleration by electron cyclotron resonance in a mirror-like magnetic field is considered. The absorption and reflection coefficients are evaluated by a method which avoids the use of the WKB approximation. A maximum of absorption is found at very high density the wave is strongly reflected. Author (NSA)

N69-16714# Oak Ridge National Lab., Tenn.
STUDIES OF OPEN-ENDED CONFINEMENT WITH ECR PLASMAS
W. B. Ard and R. A. Dandl *In its* Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 287-279 refs Sponsored by AEC (See N69-16701 06-25)
Avail: CFSTI

Plasmas produced in magnetic mirrors by ECR are characterized by a very energetic electron component co-existing with a much less energetic background plasma produced by ionization of background neutrals. The densities and velocity distribution of the two components can be controlled to some extent. This property of ECR plasmas has made them very useful for the study of "line tying" stabilization of grad-B-driven drift modes. The presence of the two temperature components has allowed investigation of instability resulting from interaction of the two components, in particular an instability that results from a coupling of the hot component to waves in the cold plasma near harmonics of the electron-cyclotron frequency. This can be classed as a loss-cone driven instability, since it is driven by a positive slope in the energy distribution function of the energetic electrons. The result of the instability is a rapid spreading of transverse electron energies with those that lose transverse energy entering the loss cone of the mirror and being lost from the plasma. Author (NSA)

N69-16715# United Kingdom Atomic Energy Authority, Culham (England).
CALCULATIONS OF PLASMA LOSS AND PLASMA POTENTIAL IN MIRROR MACHINES
D. L. Fisher, B. McNamara, and D. W. Mason *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 280-308 refs (See N69-16701 06-25)
Avail: CFSTI

Calculations by Fowler and Rankin of the steady state of plasma formed by injection of ions and electrons into mirror machines show that an economic mirror machine fusion reactor is unlikely to be feasible. The main simplifications of the model are neglect of the spatial dependence of the plasma potential and the dependence on angle in velocity space of the friction and diffusion processes. The earlier calculations of plasma loss and plasma potential are examined to show how acceptable are these simplifications. A new computer program has been written, based on the Fowler–Rankin model, to calculate the time dependence of ion and electron energy distributions and plasma potential. This program is useful in the study of actual experimental situations, and some examples of the influence on the loss of plasma of varying the mirror ratio, initial energy distributions, and injection rates are given. The new program has been used to check that an initially Maxwellian plasma with neutral injection does relax to the steady-state solutions found by Fowler and Rankin. The importance of the result for an economic mirror-machine reactor is reassessed. The conclusion is that such a reactor is feasible if (i) a way can be found of reducing the ambipolar potential (ii) a highly efficient means of injection can be devised and (iii) if stability does not limit the obtainable β to plasma densities giving uneconomic nuclear power densities. Author (NSA)

N69-16716# California Univ., Livermore. Lawrence Radiation Lab.
MIRROR CONFINEMENT AND ITS OPTIMIZATION
R. F. Post *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 309-349 refs (See N69-16701 06-25)
Avail: CFSTI

With the elimination of gross instabilities an accomplished fact, the further optimization of mirror confinement mainly hinges on satisfying two requirements: (1) Adequate suppression of high-frequency wave-particle instabilities, and (2) Minimization of enhanced end losses associated with the ambipolar potential. There is reason to believe that satisfactory solutions to both of these requirements can be found, by taking advantage of the topology and flexibility of open-ended systems. In such systems the basic problem is one of controlling the low energy end of the ion energy spectrum, since both wave-particle instabilities and ambipolar ion losses are traceable to this class of particles. The stabilizing effects of modifying ion distribution functions by the addition of "warm"

plasma components are considered. The modes considered are (1) the HIGH-frequency loss-cone convective mode and (2) the loss-cone drift cyclotron mode. It is shown that in high mirror ratio systems these two important modes should be strongly stabilized by the addition of a few percent of Maxwellian warm plasma ions with mean energies small compared to those of the contained ions. Some of the practical problems of creating such a situation are discussed.
Author (NSA)

N69-16717# California Univ., Livermore. Lawrence Radiation Lab.
THE DRIFT-CYCLOTRON INSTABILITY IN MIRROR MACHINES
T. K. Fowler *In* Oak Ridge Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 350-362 refs Sponsored by AEC (See N69-16701 06-25)
Avail: CFSTI

The drift cyclotron instability in mirror machines is reviewed. It has been conjectured that this mode will determine the radial scaling of mirror confinement. The density threshold for instability is higher the larger the ratio of plasma radius R_p to the ion Larmor radius ρ_i. For a given ratio R_p/ρ_i the density threshold is lower for more singular ion energy distributions. The mode occurs at ion-cyclotron harmonics; it results from coupling of ion-cyclotron waves to an electron drift wave. The wavelength is short, less than ρ_i, and thus perhaps difficult to detect. Stabilization by radial scaling, together with energy spreading on the ions, cold plasma and effects of magnetic curvature, are discussed quantitatively.
Author (NSA)

N69-16718*# California Univ., Livermore. Lawrence Radiation Lab.
MULTICOMPONENT PLASMA INSTABILITIES
L. D. Pearlstein *In* Oak Ridge Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 363-373 refs Sponsored in part by AEC (See N69-16701 06-25)
(Contract NASw-1211)
Avail: CFSTI

High-frequency stability of multicomponent plasmas is reviewed for two distinct modes. In both cases, the equilibrium consists of a high-temperature anisotropic or "loss-cone" limited plasma superimposed upon a low-temperature background plasma. In one, the stability of flute-like ($k_\parallel = 0$) electrostatic modes is examined. It is found that instability occurs at frequencies characteristic of electron (ion) gyrofrequencies and their harmonics, provided the species gyrofrequency (Ω) is less than the upper (lower) hybrid frequency (ω_{HY}) of the cold plasma. In this case, one finds instability if the fractional density of hot particles exceeds $(\Omega/\omega_{HY})^{1/2}$ for a small admixture of the hot plasma. In the opposite limit, instability occurs if the fractional density of cold particles exceeds $(T_c/T_H)^{3/2}$. In the second case, the $k_\parallel = 0$ restriction is removed and it is found that the region of instability now includes $\Omega/\omega_{HY} > 1$. It is also found that for this mode the temperature anisotropy is not critical.
Author (NSA)

N69-16719# Oak Ridge National Lab., Tenn.
RESONANT LOSS-CONE INSTABILITIES
C. O. Beasley, Jr., R. A. Dory, W. M. Farr, G. E. Guest, and D. J. Sigmar *In its* Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 374-407 refs Sponsored by AEC (See N69-16701 06-25)
Avail: CFSTI

Several aspects of resonant loss-cone instabilities are considered, the general properties of the unstable oscillations, particularly in plasmas containing hot electrons; the stabilization effects resulting from adding low-temperature ions to a hot-ion, hot-electron plasma and varying the energy and angle spread of the hot-ion distribution; and the behavior of these same modes at high densities, approaching reactor values. To date these studies have shown that the instabilities can be weakened or in some cases effectively eliminated by the various procedures studies. Complete stabilization may, however, rely on effects not yet understood, such as the finite length effects mentioned in this report or the effects associated with spatial variation in the confining magnetic field.
Author (NSA)

N69-16720# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
AN APPROACH TO MICROINSTABILITIES IN FINITE PLASMA SYSTEMS
Michel Cotsaftis *In* Oak Ridge Natl. Lab. Proc. of Intern. Conf. on Plasma Confined in Open-ended Geometry 4 Nov. 1967 p 408-479 refs (See N69-16701 06-25)
Avail: CFSTI

After a short discussion of a number of works attempting to include finiteness effects in open-ended systems, the simple model of a plane slab geometry is analyzed taking into account: (1) finite extension of the plasma $L = \alpha z_i$ along the magnetic field lines; (2) existence of an exterior medium (cold, warm plasma or vacuum) between the plasma and conducting plates located at a given distance $z = \pm z_e$ from the symmetry plane of the system; (3) reflection of particles at the plasma boundaries simulating mirror effect; (4) curvature of magnetic field lines simulated by a gravity g; (5) particle density and temperature gradients from the distribution function gradient; and (6) constant shear in the gravity and gradients direction and with the most general equilibrium state. In accordance with the above mentioned effects, the equation of the electrostatic perturbations of the system is given.
Author (NSA)

N69-16723# Tennessee Univ., Knoxville.
PLASMA INSTABILITIES
Edward G. Harris 1968 82 p refs
(TID-24759) Avail: CFSTI

Lectures on the various types of macroscopic and microscopic instabilities are presented. Nonlinear effects are also discussed.
NSA

N69-16816# Aerospace Corp., El Segundo, Calif. Lab. Operations.
EXPERIMENTAL STUDY OF THE MK-IA PLASMA NEUTRON SOURCE
Mitchell H. Dazey and Hugo L. L. Van Paassen Oct. 1968 44 p refs
(Contract F04695-67-C-0158)
(AD-678506; TR-0158(3220-50)-3; SAMSO-TR-68-402) Avail: CFSTI CSCL 20/9

An experimental investigation was carried out to determine the relationships between the significant parameters of an unusual pulsed neutron generator. The device employes a novel paraboloidal electrode geometry and belongs to the general class of plasma focus devices in which neutrons are generated by the compression of a dense deuterium plasma. Maximum neutron yields of the order of 10 to the 9th power neutrons/shot were obtained using a bank of six 14-microfarad capacitors at 23 kV for a bank energy of 22 kJ. The parametric variables studied included deuterium gas pressure, bank voltage, anode geometry, and electrode material in the vicinity of the focus. The neutron and x-ray spectra were measured.
Author (TAB)

N69-16820# Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences.
PLASMA DIAGNOSTIC TECHNIQUES FOR NONEQUILIBRIUM PLASMAS Annual Report, 1 Sep. 1967-30 Oct. 1968
W. H. Bloss, W. F. Fagen, S. Metz, and R. T. Schneider 30 Oct. 1968 72 p refs
(Contract Nonr-580(19))
(AD-679177; AR-2) Avail: CFSTI CSCL 20/9

A model to explain the gas-breakdown was developed and simulated with the aid of an analog computer. Experimental results verified to a large extent the theory and proved the applicability of such a model. Furthermore, several diagnostic methods were studied in order to obtain information about the various plasma parameters. The most sophisticated thereof was scattering of a laser beam by the plasma which yielded time and spatial resolved electron temperatures in the order of one million degrees Kelvin. Evaluation of Doppler-broadened, characteristic hydrogen lines made a determination of the gas temperature possible, which turned out to be in the order of 10,000K and can be assumed equal to the ion temperature. As a useful side product the development of two very sensitive detection systems was achieved, namely for low photon and neutron fluxes. The first system was already successfully employed whereas the latter will be a possible diagnostic tool for planned investigations during the next period. Author (TAB)

N69-16848# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
CYCLOTRON ECHO STUDY Final Report, 16 May 1966-31 Aug. 1968
Robert M. Hill, Gabriel F. Herrmann, and Daniel E. Kaplan Aug. 1968 93 p refs
(Contract AF 19(628)-5932)
(AD-678840; AFCRL-68-0473) Avail: CFSTI CSCL 20/9

Cyclotron resonance echoes have been explored experimentally and theoretically. The phenomenon is adequately explained in the low electron density region omega sub p < < omega sub c by a model involving the nonlinear loss introduced by the velocity dependence of the electron-neutral particle collision frequency. The effect of electron diffusion is treated formally and qualitative agreement found with experimental results. Quantitative answers on electron energy and momentum relaxation processes should result from careful experimental control of diffusion. For electron densities such that omega sub p < or > omega sub c the phenomenon is more complex and quantitative results will require a deeper understanding of the resonances which are being excited in the plasma. Reprints of work associated or inspired by this study are included. A second part of this report is a brief survey of echo phenomena, in an attempt to make this effect plausible and to point out its generality in systems made up of collections of resonators. Author (TAB)

N69-16856*# Warner and Swasey Co., New York. Control Instrument Div.
EXPERIMENTAL EVIDENCE OF DEPARTURES FROM LOCAL THERMODYNAMIC EQUILIBRIUM IN ARC PLASMAS AT REDUCED PRESSURE
Lothar Klein and Harold J. Babrov Aug. 1968 40 p refs
(Contract NASw-1566)
(NASA-CR-73656) Avail: CFSTI CSCL 20I

A wall-stabilized arc of noval design was tested and used for spectroscopic investigations of departures from local thermodynamic equilibrium (LTE) at reduced pressure. Stable arc operation was achieved in argon, nitrogen, hydrogen, water vapor, and air at pressures as low as 0.01 atm and currents up to 200 A. The spectrometer can view the arc radially (side-on) and axially (end-on). The arc was used preferentially in the end-on mode, in order to detect intrinsic departures from LTE with a minimum of laborious data reduction. The core temperature of an argon arc at 1 atm, 0.1 atm, and 0.01 atm pressure was determined from the measured absolute intensities of atomic and ionic lines. The existence of LTE was demonstrated at 1 atm pressure; 0.1 atm corresponded to a transition regime, while at 0.01 atm notable departures from LTE were observed. Author

N69-16904# Stanford Univ., Calif. Inst. for Plasma Research.
VISCOUS MAGNETOHYDRODYNAMIC FLOWS
O. K. Sonju Jul. 1968 148 p refs
(Contracts AF 49(638)-1123; F44620-68-C-0051)
(AD-678626; SU-IPR-245; AFOSR-68-2620) Avail: CFSTI CSCL 20/9

The effects in both fully developed, two-dimensional flows and boundary-layer flows of an applied transverse magnetic field and an applied parallel electric field (i.e., normal to both the flow and the magnetic field) on the dynamic behavior of electrically conducting fluids are investigated. The flow over electrically insulated walls are considered. The importance of fluid-property, in particular electrical conductivity, variations in the plasma is studied. Both laminar and turbulent flows are discussed, and experimental as well as theoretical work was performed. The influence of the electrical-conductivity profile within the plasma is studied by systematically varying the wall temperature with respect to the mean plasma temperature. The effect of the magnetic field is found to be sensitive to this temperature difference. Furthermore, turbulence-damping effects, Hall-parameter effects, and fluid-property-variation effects are discussed. A complete correlation of the data is proposed. Significant changes due to the magnetic field are observed. The calculated boundary-layer thickness and wall friction approach asymptotic values at large distances downstream of the leading edge. The boundary-layer thickness decreases with increasing magnetic interaction. The effect of a varying electrical conductivity in the boundary layer is also estimated. Author (TAB)

N69-16906# Stanford Univ., Calif. Inst. for Plasma Research.
EFFECTS OF NONELASTIC COLLISIONS IN PARTIALLY IONIZED GASES
James F. Shaw Aug. 1968 139 p refs
(Contracts F44620-68-C-0051; AF 49(638)-1695)
(AD-678627; SU-IPR-254; AFOSR-68-2621) Avail: CFSTI CSCL 20/9

A numerical solution is obtained for the coupled Boltzmann equation and rate equations, including the effects of nonelastic collisions and radiation escape. Specific topics include: The rate equations, the Boltzmann equation, and the equation of radiative transfer; simplification of the Boltzmann equation and rate equations to forms which allow analytical solutions to be found; a numerical solution for the coupled Boltzmann equation and rate equations; solutions for a hydrogen plasma in both steady-state and transient situations; the effects of photon escape and nonelastic collisions in a cesium-argon plasma; discussion of physical systems where the effects of nonelastic collisions are likely to be important. TAB

N69-16926# Aerospace Corp., El Segundo, Calif. Lab. Operations.
PREDICTIONS OF MICROWAVE BREAKDOWN IN AIR FROM KINETIC THEORY CALCULATIONS
Carl J. Leander Jun. 1968 31 p refs
(Contract F04695-67-C-0158)
(AD-678511; TR-0158(3240-20)-17; SAMSO-TR-68-409) Avail: CFSTI CSCL 20/9

A formulation of the Boltzmann equation for dc and microwave electric field excitation in a uniform, multicomponent gas has been expressed in a computer program at the National Bureau of

Standards by L. R. Megill. This program was intended for use in the study of atmospheric afterglow by NBS but was given to the Aerospace Corporation for conversion to study microwave breakdown. The conversion of the program, the alteration of the collision cross-section data pack, and the numerical verification that the program plus data pack accurately describe the response of air to high intensity microwaves are described in this report. Author (TAB)

N69-16969# Aerospace Corp., El Segundo, Calif. Lab. Operations.
OVERSTABLE MODES DUE TO RESISTIVITY GRADIENTS IN CURRENT-CARRYING PLASMA SLAB
David C. Pridmore-Brown Sep. 1968 17 p refs
(Contract F04701-68-C-200)
(AD-679110; TR-0200(9220-02)-1; SAMSO-TR-68-416) Avail: CFSTI CSCL 20/9

A preliminary study is made of overstable modes due to resistivity gradients in a current-carrying plasma slab. A restricted set of solutions satisfying a constant pressure assumption is found for the magnetohydrodynamic equations. These solutions turn out to be overstable in a certain range of the resistivity. Author (TAB)

N69-17033*# Avco-Everett Research Lab., Everett, Mass.
TWO NEW RESULTS IN CYLINDRICAL DIOCOTRON THEORY
R. H. Levy Nov. 1967 9 p refs Submitted for publication
(Contracts NAS8-20310; AT(30-1)-3863; AF 49(638)-1553)
(NASA-CR-90577; RR-283) Avail: CFSTI CSCL 20I

Two new results on the diocotron wave which propagates on crossed-field electron beams at low density are presented. One is a solution of the linearized problem valid for arbitrary unperturbed density profiles; this solution is restricted to the fundamental mode. The other result exhibits a special family of exact non-linear solutions to motion of the diocotron type. Both results contribute to a new diagnostic technique for measuring the total charge contained in cylindrical crossed-field electron beams. Author

N69-17061# Columbia Univ., New York. Plasma Lab.
PLASMA HEATING BY STRONG SHOCK WAVES Interim Scientific Report
Robert A. Gross and Bennett Miller Sep. 1968 109 p refs
(Contract AF 49(638)-1634)
(AD-678637; AFOSR-68-2681; Rept-39) Avail: CFSTI CSCL 20/9

The technology of electromagnetic devices which produce very high-speed shock waves is described. The theory of strong shock waves is summarized, and pressure driven shock tube theory and performance is briefly reviewed. The theory and technology of capacitor bank energy storage systems and auxiliary components such as switches, power supplies, cables, dielectric materials, etc. used with electromagnetic shock tubes are described. The performance of some completed systems together with some experimental results on strong shock waves is presented. Author (TAB)

N69-17102*# Techtran Corp., Glen Burnie, Md.
EROSION OF THE ELECTRODES OF PULSED PLASMA ACCELERATORS. PART 1: ANODE [OB EROZII ELEKTRODOV IMPUL'SNYKH USKORITELEY PLAZMY. 1. ANOD]
B. B. Mokshantsev et al Washington NASA Feb. 1969 11 p refs Transl. into ENGLISH from Izv. VUZ Fiz. (USSR), v. 11, no. 6, 1968 p 46-51
(Contract NASw-1695)
(NASA-TT-F-12080) Avail: CFSTI CSCL 20I

Within the interelectrode gap of a pulsed accelerator, in contrast to ordinary pulsed vacuum discharges (electric spark machining of metals, pulsed light emitters, vacuum switches, etc.), electromagnetic acceleration of the discharge takes place at velocities of 10^6–10^7 cm/sec and greater, which inevitably results in the formation of near-electrode zones and erosion of the electrodes of such equipment. The processes which take place on the surface of the anode under these conditions have not been investigated sufficiently. This work investigates the features of anode erosion and the development of anode spots in pulsed plasma accelerators of rail configuration. Author

N69-17103*# Techtran Corp., Glen Burnie, Md.
EROSION OF THE ELECTRODES OF PULSED PLASMA ACCELERATORS. PART 2: CATHODE [OB EROZII ELEKTRODOV IMPUL'SNYKH USKORITELEY PLAZMY. II. CATHODE]
B. B. Mokshantsev et al Washington NASA Jan. 1969 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved.: Fiz. (Tomsk), v. 11, no. 6, 1968 p 52-58
(Contract NASw-1695)
(NASA-TT-F-12081) Avail: CFSTI CSCL 20I

There are many publications which pertain to the investigation of cathode phenomena of an arc discharge. Up to now, however, not a single opinion has been proposed concerning the character of the physical processes which occur in the near-cathode zone and on the surface of the cathode of pulsed and stationary high current arcs. Attention has been focused on these processes in recent years in connection with the determination of the great role played by the near-electrode phenomena which occur in devices used for the acceleration of plasma. This work investigates the features of the destruction of the cathode surface and of the dynamics of cathode spots in pulsed plasma accelerators of rail configuration. Author

N69-17107# Technische Hochschule Hannover (West Germany). Institut fuer Plasmaphysik.
CALCULATION OF TRANSITION PROBABILITIES IN ARGON
H. Meiners Jul. 1968 31 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-68-34) Avail: CFSTI

The absolute scaling factor α^2 is computed from Hartree–Fock–Slater wave functions. The results are compared with the results of Coulomb approximation according to Bates and Damgaard as well as with experimental data. From the discussion of those transitions showing considerable differences between the results of Coulomb approximation and Hartree–Fock–Slater computations a criterion for the nonapplicability of the Coulomb approximation in certain cases is deduced. Especially the reasons for the well known failure of this approximation for the prominent Ar I transition $3p^54s \rightarrow 3p^55p$ are shown. For a great number of further transitions of the argon spectrum the absolute scaling factors α^2 computed from Hartree–Fock–Slater wave functions are tabulated. Author (NSA)

N69-17138# Academy of Sciences (USSR), Leningrad. Physics-Technical Inst.
SUPERHIGH FREQUENCY GENERATION OF STRONGLY IONIZED ARGON PLASMA
A. I. Anisimov, N. I. Vinogradov, V. E. Golant, S. I. Nanobashvili, and L. P. Pakhomov 1968 8 p refs In RUSSIAN
(NP-17674) Avail: CSFTI

An argon-filled cylinder with initial pressure of 5×10^{-4} to 5×10^{-2} mm Hg was used along with two sources, one with pulse duration of 1 sec and 200-W energy and the other with 20-μsec pulse duration and 20 kW energy. In the range studied

(p = 5 × 10 $^{-4}$ to 5 × 10 $^{-2}$ mm Hg) the pulse duration exceeded considerably the time interval between ionization collisions. Graphical data obtained for various superhigh-energy levels showed that the specific energy near 150 W. cm $^{-3}$ and at pressures less than 10 $^{-3}$ mm Hg it is possible to obtain plasma densities of 10^{13} to 5 × 10^{13} cm $^{-3}$, electron energy 6 to 10 eV, and almost complete ionization. NSA

N69-17160# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Institut.
MASS-ENERGETIC MEASUREMENTS OF PLASMA ENTRAPPED INTO THE APERTURE OF THE DIVERTER DURING INJECTION THROUGH THE MAGNETIC GAP
V. M. Zalkind, V. G. Zikov, V. I. Karpukhin, N. I. Pudnev, and V. T. Tolok. 1968 12 p refs In RUSSIAN
(NP-17665) Avail: Issuing Activity

With the help of a Thomson mass spectrograph and a flight mass spectrometer, the energy spectra, mass structure, and other parameters of a plasma, entrapped in the aperture of the diverter during an external injection through its magnetic gap from a coaxial plasma gun, were studied. It was shown that there is an optimal intensity of magnetic field during which there occurs the greatest percentage of absorption of hydrogen ions along the axial force lines of the magnetic field. The best absorption of the high-energy ions occurs approximately in this range of the magnetic fields. Author (NSA)

N69-17161# Akademy of Sciences (USSR). Leningrad. Fiziko-Tekhnicheskii Institut.
STUDIES OF SUPERHIGH-FREQUENCY HEATING OF PLASMA IN MAGNETIC FIELD
A. I. Anisimov, V. N. Budnikov, N. I. Vinogradov, V. E. Golant, S. I. Nanobashvili et al. 1968 23 p refs In RUSSIAN
(NP-17655) Avail: Issuing Activity

The feasibility of expanding the range of conditions for effective introduction of superhigh-frequency energy into plasma is discussed. The results of theoretical studies of wave absorption by collisionless plasma are interpreted in detail. The experiments on formation and heating of plasma by superhigh-frequency waves are described and the effective wave absorption region was found. It is shown that effective wave absorption related to linear transformation can be realized in a wide range of conditions and effective introduction of superhigh-frequency energy into plasma in a wide range of parameters (with magnetic fields from small intensities up to magnitudes exceeding cyclotron fields and particle concentrations from less than critical up to the magnitudes exceeding the critical by order of two). NSA

N69-17162# Academy of Sciences (USSR). Moscow. Institut Fiziki.
STABILITY OF INHOMOGENEOUS HOT PLASMA FLOW
I. S. Baikov. 1968 14 p refs In RUSSIAN *Its* Preprint No. 89
(NP-17656) Avail: Issuing Activity

The kinetic theory of steady laminar flow of inhomogeneous plasma along a magnetic field is discussed. It is shown that under phase resonance conditions, between the rate of the flow and the acoustic or drift wave, new instabilities appear in plasma caused by the flow rate gradient. The instability increment can exceed considerably the frequencies of plasma drift oscillations. Author (NSA)

N69-17171# United Kingdom Atomic Energy Authority, Culham (England).
TRANSFER PROCESSES IN TOROIDAL SYSTEMS
L. Kovrizhnykh. Sep. 1968 17 p refs Transl. into ENGLISH from Lebedev Preprint (Moscow), no. 98, 1968 p 1-18
(CTO/542) Avail: Issuing Activity

Expressions are derived for the particle and energy fluxes across the magnetic field in toroidal magnetic systems of various types such as the Tokamak, Lavitron, Stellarator, "corrugated" Torus, for a fully and weakly ionized plasma. It follows that, given a sufficiently small collision frequency, consideration of the toroidicity leads to a significant increase of the coefficients of diffusion and thermal conductivity compared to straight systems (i.e. $\varepsilon = r/R = 0$). A region of parameters (low collision frequencies or sufficiently high electric fields) appears to exist where the transfer coefficients are independent of the magnetic field strength. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N69-16161# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
TEMPERATURE DEPENDENT STUDY OF THE DIELECTRIC DISPERSION OF A VARIETY OF INORGANIC SOLIDS Final Scientific Report, 15 Aug. 1966-14 Aug. 1968
Clive H. Perry. Sep. 1968 113 p refs
(Contract AF 19(628)-6066)
(AD-679213; AFCRL-68-0561) Avail: CFSTI CSCL 20/2

A temperature-dependent study of the vibrations of crystal lattices was undertaken using infrared and Raman techniques. The frequencies of the normal modes of lattice vibration so determined give results related to the properties of the materials and assist in deduction of interatomic force laws and anharmonic effects. Author (TAB)

N69-16223 Florida Univ., Gainesville.
AN INTERPRETATIONAL STUDY OF FIELD ION MICROSCOPE IMAGES
Roger Carl Sanwald (Ph.D. Thesis) 1967 178 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-9554

Two computer models, neighbor model and shell model, were presented to aid in the interpretation of field ion micrographs of both perfect crystal structures and crystal structures containing defects. The development of the neighbor model, which uses the geometrical environment, or equivalently the atomic binding energy, as an imaging criterion, resulted in point for point agreement with an experimental image. It was shown that variation in intensity on a single plane correlates well with changes in local sublimation energy; however, it appears that additional energy terms are required for intensity variations between planes. The shell model was used to predict defect configurations in field ion images in the FCC, BCC, and HCP systems. Basically all line defects and defect configurations composed of total dislocations could be interpreted in terms of spirals by using the $\vec{g} \cdot \vec{b}$ criterion. Therefore, the important parameter in determining the resulting configuration in the micrograph is the component of the Burgers vector normal to the set of planes on which the dislocation emerges. Dissert. Abstr.

N69-16248# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN INVESTIGATION OF THE RECOMBINATION RADIATION FROM p-n JUNCTIONS IN GALLIUM ANTIMONIDE

I. V. Kryukova 8 Feb. 1968 9 p refs Transl. into ENGLISH from the book "Fizika p-n Perekhodov" Riga, Zinatne, 1966 p 310–315
(AD-678788; FTD-HT-23-1475-67) Avail: CFSTI CSCL 20/5

The specific features of carrier, injection-generated electroluminescence of gallium antimonide, alloyed and diffused p-n junctions, biased in the forward direction, are studied. GaSb p-type diodes were made by alloying 99% Pb + 1% Te and 99% Sn + 1% Te beads at 400C into p-type GaSb crystal, with a hole concentration of 1.5 x 10 to the 17th power hole/cu cm. The n-type GaSb junctions were made by the diffusion of Zn at 580C. The n-type material was doped with Te, with a resulting electron concentration and mobility of 2.4 x 10 to the 17th power el/cu cm and 2700 sq cm/v sec, respectively. Diodes were tested using 2 microsec pulses, with a frequency of 40 Hz. Radiation was detected by means of lead sulfide photoresistors. The results show that alloyed junction diode radiation is confined to a narrow spectrum centered at 0.760 plus or minus 0.005 eV with a halfwidth of 0.02 eV. However, the recombination radiation spectrum of diffused p-n junction depends on the applied current density. When the current density is relatively small, one peak at 0.73-0.74 eV is observed. One order of magnitude increase in current density causes a second peak to appear at 0.756 plus or minus 0.005 eV, and when the current density reaches 60,000 amp/cu cm, the spectrum contains one intense peak at 0.787 plus or minus 0.005 eV. The recombination of injected carriers takes place at identical levels located near the valence zone. However, the reason for the observed narrowing of the spectrum could not be established.
TAB

N69-16261# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTRIBUTION TO THE THEORY OF TRANSPORT PROCESSES IN SOLIDS AT LOW TEMPERATURES [K TEORII PROTSESSOV PERENOSA V TVERDYKH TELAKH PRI NIZKIKH TEMPERATURAKH]
R. N. Gurzhi (Ph.D. Thesis—Akad. Nauk USSR, Moscow) 8 Mar. 1968 105 p refs Transl. into ENGLISH from Russian
(AD-679399; FTD-MT-24-402-67) Avail: CFSTI CSCL 20/12

The report discusses the theory of transport processes to include solids (dielectrics, metals, and ferrites) in the case when normal collisions between quasiparticles have maximum probability. It is shown that although normal collisions do not lead themselves to a finite resistance, they can strongly affect the resistance produced by other scattering processes, so that the kinetic coefficients and their dependence on the temperature and other parameters are appreciably altered. The character of the influence of normal collisions depends strongly both on the type of the quasiparticles (electrons, phonons, spin waves) and on the nature of the mechanism leading to the loss of quasimomentum (Umklapp collisions with impurity atoms, with sample boundaries, etc.).
TAB

N69-16289 Michigan State Univ., East Lansing.
FRACTURE IN ZINC CRYSTALS
Bhupendra Umedchand Shah (Ph.D. Thesis) 1967 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-7964

A multiple-slip-band model for fracture in zinc crystals based on the stress concentration due to piled-up groups of dislocations on many nearby slip bands has been developed. The stress concentration factor for each of the various stress components of the stress field of the dislocation pile-ups near a grain boundary is calculated as a function of the geometric and deformation variables. The results indicate that for the same number of dislocations per slip band the stress concentration ahead of the dislocation pile-ups is long-ranged and much higher than what is obtainable with the single-slip-band model, while the stress concentration on the side of the pileups is short-ranged and not as high. Experiments with asymmetric zinc bicrystals with controlled orientations show that fracture always takes place in the neighboring crystal grain ahead of the slip bands, and is caused mainly by the shear stress acting on the cleavage plane substantiating the present theory.
Dissert. Abstr.

N69-16310# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC RELAXATION OF NUCLEI IN SEMICONDUCTORS AND SEMIMETALS IN A QUANTIZING MAGNETIC FIELD
G. R. Khytsishvili et al 5 Apr. 1968 17 p refs Transl. into ENGLISH from Elektronnye i Ionnye Protsessy v Tverd. Telakh (USSR), no. 2, 1965 p 72–81
(AD-679375; FTD-HT-23-1529-67) Avail: CFSTI CSCL 20/12

The relaxation time of nuclei in semiconductors or semimetals in a magnetic field of such intensity that the quantization of electron space motion becomes essential, is calculated. Cases of nondegenerate and strongly degenerate carrier gas are studied. Relaxation is presumed to occur at the expense of contact interaction of nuclear spins with conduction electrons. It is supposed that the energy zones possess the isotropic quadratic law of dispersion. The presence of peaks in transition probability is established. These peaks are more strongly expressed when a small quantity of Landau subzones is populated. In a number of cases these peaks form two series.
TAB

N69-16324# Stanford Univ., Calif. High Energy Physics Lab.
APPLICATIONS OF THE FOUNTAIN EFFECT IN SUPERFLUID HELIUM
C. M. Lyneis, M. S. Mcashan, and H. A. Schwettman Sep. 1968 15 p refs
(Contract Nonr-225(67))
(AD-678719; HEPL-577) Avail: CFSTI CSCL 20/13

The fountain pressure pump appears to offer a simple and efficient way to provide cooling a distance from a central refrigerator as well as a means for transfer of liquid helium below the lambda point. Experiments are in progress to demonstrate the usefulness of the fountain pressure pump in large scale systems.
Author (TAB)

N69-16357# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A THEORY OF SUPERCONDUCTIVITY IN A PHONON MODEL
I. O. Kulik 22 Jan. 1968 16 p refs Transl. into ENGLISH from Elektron. Svoistva Metal. Splavov, Akad. Nauk Ukr. SSR (Kiev), 1966 p 4–17
(AD-679389; FTD-HT-23-1488-67) Avail: CFSTI CSCL 20/13

The report considers a theory of superconductivity in a phonon model at ultimate temperatures. It is also attempted to prove that this theory leads to results agreeing with the corresponding results of the theory of superconductivity based on the Hamiltonian model of Bardin. Formulas are derived with the aid of thermodynamic perturbation theory.
TAB

N69-16369 Duke Univ., Durham, N. C.
A STUDY OF SPIN-WAVE SPECTRA AND SURFACE EFFECTS IN THIN NICKEL FILMS DEPOSITED IN ULTRA-HIGH VACUUM
William Forrest Chambers (Ph.D. Thesis) 1967 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-6893

Multiple spin wave resonances have been observed in thin nickel films deposited on glass substrates held at elevated temperatures.

Shadowed surface replica and direct transmission electron micrographs of these films show that they have very rough surfaces: many surface bumps are nearly as high as the films are thick. It has been deduced from the surface measurements that the stress patterns in such films are very complex and that a dynamic pinning model yielding weak pinning through an internal stress field variation or through a surface-bump-caused variation in the internal magnetic field intensity will provide the most appropriate model for a theoretical analysis of spin wave resonance in such films. Measurements of average grain size and surface bump heights in the films indicate that the film formation mechanism proposed by Wilman is applicable to films deposited in UHV. Dissert. Abstr.

N69-16400 National Lending Library for Science and Technology, Boston SPA (England).

RELATIONSHIP BETWEEN THE THERMAL STABILITY OF F COLOUR CENTRES AND THE DISLOCATION DENSITY IN NACL CRYSTALS [SVYAZ MEZHDU TERMICHESKOI STABILNOSTYU F-TSENTROV OKRASKI I PLOTNOSTYU DISLOKATSII V KRISTALLAKH NACL]

V. I. Sidlyarenko et al Oct. 1968 8 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 4, 1967 p 87-90 (NLL-RTS-4841) Avail: Natl. Lending Library, Boston Spa., Engl.: 10s

A correlation is established between the thermal stability of the F color centers and the dislocation density in pure and doped crystals. It is shown that, other things being equal, the thermal stability of the F color centers is directly related to the dislocation density in the crystal. The findings agree qualitatively with the hypothesis of the ionic nature of the color centers bleaching process. Dislocations can act as capture centres for the ions which participate in F color centers bleaching. Author

N69-16402# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.

PERSISTENCE AND AMALGAMATION TYPES IN OPTICAL SPECTRA OF MIXED CRYSTALS

Hirotsugu Matsuda and Takashi Miyata Nov. 1968 32 p refs (RIFP-79) Avail: CFSTI

The optical spectra of substitutional mixed crystals of the type AB_xC_{1-x} can be classified into two types, persistence and amalgamation types (p- and a-type). In the former, two structures corresponding to the two constituent substances do persist. In the latter, they are amalgamated in a single one. The exact criterion for the p-type behavior is given for the isotopic mixed crystal, Frenkel exciton model and Rosenstock-Newell model in connection with the Saxon-Hutner theorem. The criterion for the a-type behavior is numerically investigated for the one-dimensional model of mixed crystals. The result is compared with the infrared experiments of various mixed crystals. Possible failure of the Saxon-Hutner theorem is pointed out in the non-isotopic mixed crystal. The importance of the change of optical band edges with concentration of constituents is emphasized for analyzing the nature of the force field. Author

N69-16406 National Lending Library for Science and Technology, Boston Spa (England).

ANOMALOUS DIFFUSION OF X-RAYS BY BLENDE TYPE SEMICONDUCTORS

Claude Schiller and Brigitte Larousse 19 Nov. 1968 6 p refs Transl. into ENGLISH from J. Appl. Cryst. (France), v. 117, no. 1, 1968 p 117-118 (NLL-PORS-Trans-2524-(9022.81) Avail: Natl. Lending Library, Boston Spa, Engl.

By the use of the continuous X ray spectrum it is possible to determine the polarity of semiconductors of the blende type. Close to the absorption edges the scattered intensities are different for (111) and (1$\bar{1}\bar{1}$) faces. Author

N69-16481*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

GUIDANCE AND CONTROL RESEARCH

In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 68-77 refs (See N69-16475 06-07) Avail: CFSTI CSCL 20L

To determine the electron concentration at the boundary of the metal contact to vacuum-cleaved surfaces of photoconducting CdS at various temperatures and light intensities, an analysis was made of high field domains in the range of negative differential conductivity. Preliminary results indicate that the concepts of contact barriers are not useful when relatively high currents are flowing. Published values of barrier heights on semiconducting CdS are included. The experimental apparatus used for normal and Curie-point switching experiments are described, and the significance of some preliminary findings are discussed with respect to memory and recording applications. The guidelines are listed for establishing design criteria to optimize germanium solid state diodes for noise measurements. It is reported that an optical system was constructed for defining and aligning the contacts through the use of photo-resist techniques. M.G.J.

N69-16531 Delaware Univ., Newark.

RATES OF CRYSTALLIZATION FROM BINARY MELTS

Donald Joseph Kirwan (Ph.D. Thesis) 1967 185 p Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-9602

The rates of crystal growth from subcooled liquid mixtures were observed in the simple binary eutectic system composed of salol and thymol and in the isomorphous system of bibenzyl and stilbene. A microinterferometric method was used to explore liquid compositions and composition gradients near the growing face of a crystal. An absolute rate theory expression, based on a plausible model of the activated state for crystallization, was developed for the crystal growth rate of a component from the melt. The theory predicts the growth rates of pure materials, except for liquid metals, within approximately an order-of-magnitude. The growth rates varied over seven orders-of-magnitude and the melt viscosities over three. For the salol-thymol binary system, the theory adequately represents the composition and temperature dependence of the crystal growth rate as well as predicting the growth rates within an order-of-magnitude. Application of the absolute rate theory predicts the composition of a mixed crystal forming from a binary melt under non-equilibrium interfacial conditions. The solid composition is not that corresponding to equilibrium with the liquid except at small undercoolings from the liquidus temperature. Dissert. Abstr.

N69-16629# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE POSSIBILITY OF MEASURING THE OPTICAL CHARACTERISTICS OF PACKED SCINTILLATORS

Ye. P. Mokhir et al *In its* J. of Appl. Spectry. 17 Jan. 1968 p 137-143 refs (See N69-16610 06-34) Avail: CFSTI

The scintillation light self-absorption coefficient in NaI(Tl) crystal packed in standard container was determined by measurement of the crystal light output. The scintillator output window was screened by various diaphragms. Comparison of the data obtained by the proposed methods with the results of the optical measurement of the absorption coefficient confirms the validity of the methods used. Author

N69-16637# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEASUREMENT OF LUMINESCENCE SPECTRA OF ANTHRACENE SIGNLE CRYSTALS WITH A NAPHTHACENE IMPURITY ON COOLING TO THE TEMPERATURE OF LIQUID HELIUM

V. K. Gorshkov et al. *In its* J. of Appl. Spectry. 17 Jan. 1968 p 176-179 refs (See N69-16610 06-34)
Avail: CFSTI

The change of luminescence spectra of anthracene crystals was studied with different naphthacene concentration under cooling to the temperature of liquid helium. An intense increase of anthracene luminescence intensity and a weak luminescence change of naphthacene was found. Author

N69-16664*# Northrop Corp., Hawthorne, Calif.

EFFECTS OF IMPURITIES ON CARRIER LIFETIME IN BULK SOLAR-CELL MATERIAL Quarterly Report

Nov. 1968 10 p Prepared for JPL
(Contracts NAS7-100; JPL-952256)
(NASA-CR-73642; NCL-68-75R) Avail: CFSTI CSCL 20L

Lifetime samples have been prepared from crystals containing Na, Be, Cl, and Al dopants and from B- and P-doped crystals containing very high oxygen concentrations. Preliminary measurements indicate that neither the Be nor the Cl doped material will be satisfactory for lifetime studies because of the poor quality of the material. Studies of lifetime degradation in various materials by 2 MeV electrons and the subsequent recovery of lifetime by thermal annealing indicate that both the damage rate and annealing behavior are strongly dependent upon the type of impurities in the sample. Isochronal annealing studies were performed on five identical samples which had been irradiated with a relatively low dose of Co^{60} gamma-rays. Although the samples had been completely annealed following a previous irradiation in which each received a different dose, the amount of recovery during the second anneal was dependent upon the dose received during the first exposure. An attempt to distribute Li uniformly throughout a large bulk sample by diffusion in an inert atmosphere proved unsuccessful. Author

N69-16685 Pennsylvania Univ., Philadelphia.

CURRENT-STRICTION IN THE MANY VALLEY SEMICONDUCTOR GERMANIUM

Philipp Gerhardt Kornreich (Ph.D. Thesis) 1967 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-9212

Several years ago electro-mechanical oscillations were observed with a small area metallic contact to a *high resistivity* germanium crystal. A simple equivalent-circuit analysis suggested the existence of an electrostrictive coupling 10^6 times larger than the one expected from conventional electrostriction mechanisms. Early, direct measurements of this electrostrictive effect seemed to corroborate the sought-for values. The purpose of this work was to extend and refine these measurements and to develop a theory that would explain this novel effect. The theory that was then developed shows the effect to be an inherently irreversible phenomenon, associated with the presence of a current in the semiconductor. To emphasize the non-equilibrium nature of the effect, and to distinguish it from conventional electrostriction, it is referred to as "currentstriction." Dissert. Abstr.

N69-16753 California Univ., Berkeley.

STRAIN-HARDENING OF LONG RANGE ORDERED AgMg SINGLE CRYSTALS

Jack Blake Mitchell (Ph.D. Thesis) 1967 61 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-10374

The deformation behavior of single crystals of long-range ordered δ phase (CsCl structure) AgMg was investigated to determine the effect of orientation on the rate of strain hardening. Specimens with tensile axis oriented near the [001] direction exhibited classical single crystal stress-strain curves having a short region of easy glide followed by a linear region of relatively low strain hardening. In contrast, specimens oriented near the [011] and [111] directions yielded parabolic stress-strain curves with very high rates of strain hardening arising from athermal dislocation barriers. This anisotropic strain hardening behavior is qualitatively consistent with the mechanism of forming athermal barriers to the motion of super-dislocations by creation of tubes of antiphase boundary during glide arising from the formation of non-aligned jogs on halves of mobile super-dislocations as a result of intersection with mobile forest dislocations. Dissert. Abstr.

N69-16771 Michigan Univ., Ann Arbor.

NONISOTHERMAL WAVE PROPAGATION AND INSTABILITIES IN BULK SEMICONDUCTORS

James Edwin King (Ph.D. Thesis) 1967 357 p
Avail: Univ. Microfilms: HC $16.20/Microfilm $4.60 Order No. 68-7645

The purpose of this study is to investigate wave propagation in semiconductors in order to predict bulk wave instabilities and to compare them with experimental results. The model that is characteristic of III-V semiconductors was chosen to represent indium antimonide. Isotropic holes and electrons, and energy dependent polar optical phonon and acoustic phonon scattering, are considered. Both the energy and momentum scattering terms for both types are obtained to nth order as functions of carrier velocity and temperature. A similar small-signal analysis, which includes the effects of both acoustic phonon and optical phonon interband and intraband energy dependent scattering as well as the band structure, is carried out for a model characteristic of germanium, a multivalley semiconductor with elliptic bands. The static solutions indicate the presence of the Sasaki-Shibuya effect and also of anisotropies introduced in the acoustic phonon scattering terms. Dissert. Abstr.

N69-16783# Stanford Research Inst., Menlo Park, Calif.

GROWTH, PROCESSING AND CHARACTERIZATION OF BETA-SILICON CARBIDE SINGLE CRYSTALS

R. W. Bartlett, R. A. Mueller, and M. Barlow Aug. 1968 52 p refs
(Contract F19628-67-C-0243)
(AD-678880; AFCRL-68-0543; SCIENTIFIC-3) Avail: CFSTI CSCL 20/2

Epitaxial vapor deposition of beta-silicon carbide on (111) beta-silicon carbide platelets and diborane doping were used to grow p-type layers on n-type substrates. Etching and thin film metallizing procedures were developed for silicon carbide, a chlorine-oxygen gas etch at 900 degrees C being used. Specific surface characteristics of solution-grown crystals, epitaxial crystals, and crystals etched in various fluids were correlated with crystal polarity. Author (TAB)

N69-16802# Clarkson Coll. of Technology, Potsdam, N. Y. Dept. of Physics.

HEAT TREATMENT EFFECTS ON SOME PHYSICAL PROPERTIES OF METALLIC SINGLE CRYSTALS Final Scientific Report

Martin C. Martin Jul. 1968 19 p refs
(Grant AF-AFOSR-794-65)
(AD-678931; AFOSR-68-1718) Avail: CFSTI CSCL 11/6

Results on the effect of plastic deformation on the electrical resistivity of high purity polycrystalline copper, aluminum and nickel

showed the change in electrical resistivity with plastic strain was not affected by strain rate over the range investigated. Extended work on nickel showed that stages 2 and 3 of plastic deformation were well defined for that metal. The results of the effect of quenching on the electrical resistivity of beta-brass showed two resistivity peaks for resistivity measurements made 3 minutes after quenching and one resistivity peak for resistivity measurements made approximately 18 hours after quenching in the relative change in resistivity versus quench temperature graphs. Results on X-ray analysis of beta-brass after quenching provided no evidence for the formation of antiphase domains or that a large amount of disorder can be quenched in. There was some evidence that stacking faults might be formed in the crystal by the quenching process. Author (TAB)

N69-16877# New York Univ., N. Y. Dept. of Physics.
MECHANISMS OF ENERGY TRANSFER IN DIELECTRICS Semiannual Report, 1 Oct. 1967–30 Jul. 1968
Werner Brandt Jun. 1968 87 p refs
(Contract DA-28-043-AMC-01999(E))
(AD-679141; ECOM-01999-4) Avail: CFSTI CSCL 20/12

A study of the processes determining moderation of electrons at energies below the internal ionization threshold of a dielectric is made. The probe used is the positron through its annihilation characteristics under a static electric field. These characteristics are related to the cross sections for electronic scattering and energy loss. Measurement on the positron annihilation spectrum of the insulators polyethylene and Teflon are given. As part of the work, we have improved the performance of subnanosecond delayed coincidence apparatus. In related work, data on the positron annihilation spectra of powders of small particle size is used to calculate positronium diffusion constants in the substances. Such powders can serve as high yield sources of free ortho-positronium and of gamma rays with continuous energy spectra. Investigation indicates a correlation between defect concentration and intensity of the longlived component of the positron annihilation spectra in alkali halides. The method of positron annihilation can provide an attractive complement to studies on color centers. Author (TAB)

N69-16925# Aerospace Corp., El Segundo, Calif. Lab. Operations.
THE UNIT CELL OF THE A-FORM OF POTASSIUM METAPHOSPHATE
Gerard M. Wolten and Armond B. Chase Jul. 1968 10 p refs
(Contract F04695-67-C-0158)
(AD-678509; TR-0158(3250-10)-16; SAMSO-TR-68-407) Avail: CFSTI CSCL 20/2

The lattice parameters and the space group of the A-form of KPO_3 have been determined from single crystals. Author (TAB)

N69-17038 National Lending Library for Science and Technology, Boston Spa (England)
INVESTIGATION OF THE PHASES IN SEMICONDUCTOR SYSTEMS
L. S. Palatnik and E. K. Belova 23 Oct. 1968 16 p refs Transl. into ENGLISH from Zh. Neorg. Materialy (Kharkov), v. 3, no. 12, 1967 p 2194-2202
(NLL-RRE-Trans-209-(8036.625)) Avail: Natl. Lending Library, Boston Spa, Eng.

The interaction of semiconductor phases in binary alloy systems of the type A(I)C(VI)-B(III)C(VI) is examined in view of new data obtained on the phase diagrams of such systems. The methods of synthesis structure and properties of the alloys are also described. The binary systems investigated were: Cu_2Te-Ga_2Te_3; Cu_2Se-Ga_2Se_3; Ag_2Te-Ga_2Te_3; Ag_2Se-Ga_2Se_3; and Cu_2S-Ga_2S_3. Phases of variable composition on the basis of $A(I)B(III)C_2(VI)$ were observed in all systems. Ordered $A(I)B_5(III)C_8(VI)$ were observed in the Cu_2S-Ga_2S_3, Cu_2Se-Ga_2Se_3 and Ag_2Te-Ga_2Te_3 systems, and the region over which such phases are homogeneous in systems with copper are greater than in those with silver. Significant regions of solid solutions on the basis of $B_2(III)C_3(VI)$ exist in all systems. Substantial changes in the nature of the chemical bond occurs with ordering of the cations in the ternary semiconductor phases. For this reason, solubility in systems of the ternary ordered phase-binary compound type is restricted and significant two phase regions occur in them. A.C.R.

N69-17063# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
SPIN WAVE INSTABILITIES AND RELAXATION IN SINGLE CRYSTAL PERMALLOY
Albert Fenner Milton Sep. 1968 187 p refs
(Contract N00014-67-A-0298)
(AD-678914; TR-573) Avail: CFSTI CSCL 20/12

The principal conclusion is that there exists in single crystals of 81-19% Ni-Fe alloy a temperature independent and k independent relaxation mechanism or combination of mechanisms which results in an X band spin wave linewidth delta H sub k of 75 Oe plus or minus 15 Oe. This corresponds to an energy relaxation time of 7.15 x 10 to the -10th power sec. for spin waves at 8.4 GHz. The fact that this PPI result is not dominated by inhomogeneous broadening has been demonstrated by achieving the same result from two samples of very different surface finish which had very different FMR resonance lines. Author (TAB)

N69-17064# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ULTRASONIC ATTENUATION BY INTERACTION WITH THE SOFT OPTIC MODE $KTaO_3$
Harrison H. Barrett Sep. 1968 98 p refs
(Contract N00014-67-A-0298)
(AD-678911; TR-571) Avail: CFSTI CSCL 20/12

Ultrasonic attenuation and velocity in KTaO3 has been measured from 180-900 MHz. over the temperature range 2-300K. Both longitudinal and transverse waves were studied. While for transverse waves the attenuation and velocity behaved normally, for longitudinal waves they showed a rapid temperature dependence at low temperature. The longitudinal attenuation was much larger than the transverse attenuation and showed a large peak at 30K. At 4.2K it varied as the square of the ultrasonic frequency (at low frequency). These observations are explained, quantitatively at low temperature and qualitatively over the entire range, in terms of an Akhieser type interaction with the soft optic mode. The Gruneisen constant and k = 0 frequency for the soft mode are obtained from the analysis. Also some information about the soft mode dispersion is obtained. The Gruneisen constant so determined is in fair agreement with that determined from a phenomenological theory using electrostrictive constants. The k = 0 soft mode frequency is in excellent agreement with Raman and infrared results. The effective relaxation time for the interaction is shown to involve both acoustic and optic mode relaxation times. Author (TAB)

N69-19138# Brookhaven National Lab., Upton, N. Y.
COUPLING LOSSES IN SUPERCONDUCTING CAVITIES
H. Hahn and J. M. Miller [1968] 7 p refs Presented at Summer Study on Superconducting Devices and Accelerators, Upton, N. Y., 10 Jun.-19 Jul. 1968 Sponsored by AEC
(BNL-12871) Avail: CFSTI

The losses of a piston-type coupling mechanism which consists of a coaxial cable with a coupling loop and a below-cutoff tube coupled to the TE_{011} cavity through an iris were studied. The coupling to the cavity by means of waveguides can be made

practically lossless and are not considered here. It was possible to derive expressions for the maximum measurable quality factor which suggest ways of reducing the residual losses due to the coupling mechanisms. Previously published Q measurements are analyzed in regard to coupling losses and it is concluded that the residual losses must have a different origin. Author (NSA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N69-16153*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONEQUILIBRIUM CALCULATIONS OF METHANE FLUORINE OXYGEN AND BUTENE-1-FLUORINE OXYGEN ROCKET PERFORMANCE
David A. Bittker Washington Jan. 1969 39 p refs
(NASA-TN-D-4991) Avail: CFSTI CSCL 21I

Equilibrium and kinetically limited performance, calculated using a one-dimensional model, are presented for methane and butene-1 rocket fuels combined with fluorine-oxygen mixtures for chamber pressures of 100 and 300 psia (6.895×10^5 and 2.069×10^6 N/m^2) and the oxidant-fuel ratio range of 2.5 to 6. Rate-controlling chemical reactions in the recombination process are identified and quantitatively rated in importance. Performance sensitivity to rate-constant uncertainty is studied in detail. It is shown that a one-dimensional kinetic flow model can be used to calculate performance in satisfactory agreement with the available experimental data and that no more than three reactions are rate controlling on the entire process. Author

N69-16195*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THEORETICAL NONEQUILIBRIUM PERFORMANCE OF OXYGEN DIFLUORIDE-DIBORANE ROCKET PROPELLANT
David A. Bittker Washington Jan. 1969 28 p refs
(NASA-TN-D-4992) Avail: CFSTI CSCL 21I

Theoretical performance, both equilibrium and rate-limited, is presented for the oxygen difluoride-diborane propellant system. A one-dimensional kinetic flow model was used. The work also includes identification of the rate controlling chemical reactions in the recombination process. Reactions are quantitatively rated in importance and the sensitivity of performance to the uncertainty of individual rate constants is studied in detail. Results indicate that the hydrogen-atom recombination is the predominant reaction in the entire process as far as performance is concerned and that no reaction involving boron species has a significant effect on performance. The theoretical performance level of oxygen difluoride-diborane is significantly higher than that for the methane-fluorine/oxygen propellant, the most energetic of the hydrocarbon-fluorine/oxygen systems. Author

N69-16220*# Atlantic Research Corp., Alexandria, Va.
DETERMINATION OF THERMODYNAMIC PROPERTIES OF AEROZINE-50 Final Report
Joseph P. Copeland and John A. Simmons 8 May 1968 125 p refs
(Contract NAS9-6720)
(NASA-CR-92463) Avail: CFSTI CSCL 21I

This report describes the results of a program to determine the thermodynamic properties of the propellant, Aerozine-50 (assumed to be a 1:1 mixture of hydrazine and UDMH) and presents charts and tables showing the corresponding values of enthalpy, entropy, phase composition, pressure, temperature and specific volume. Properties at pressures of 0.001 to 60 psia and at temperatures of −100 to 250°F were of primary interest. The first phase of the program included:(1) a survey and evaluation of pertinent data reported in the literature, (2) selection of the most appropriate methods of correlating the data and calculating values of the thermodynamic properties, (3) determination of what data is lacking or unreliable, and must be measured, (4) delineation of the experiments and techniques to accomplish this, and (5) selection of the most appropriate means to present the derived thermodynamic properties. Phase II of this program consisted of the final design and construction of the required experimental apparatus, the performance of the measurements, correlation of the data and preparation of the charts and tables. Author

N69-16483*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLID PROPELLANT ENGINEERING
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 91-97 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 21I

Experiments were conducted to ignite materials whose thermal and chemical properties are carefully controlled with a bridgewire at varying known energy input rates. It was felt that, with proper analysis, the conventional power versus time-to-fire curve would give an ignition temperature–time relationship, thereby providing a constant temperature ignition or a regular temperature–time-to-fire dependence. The results were largely negative, with no single ignition temperature found, nor was a single, fundamental relationship between ignition temperature and time-to-fire established. Static test data are also included on the Applications Technology Satellite motor. M.G.J.

N69-16889*# Atlantic Research Corp., Alexandria, Va.
DETERMINATION OF THERMODYNAMIC PROPERTIES OF AEROZINE-50 Final Report, Appendix D
Joseph P. Copeland and John A. Simmons 8 May 1968 58 p
(Contract NAS9-6720)
(NASA-CR-92464) Avail: CFSTI CSCL 21I

Tables of thermodynamic properties and skeletal thermodynamic diagrams for Aerozine-50 are presented. For the condensed phase regions, values are listed at various temperatures along the solid-vapor or liquid-vapor boundary only, since the pressure dependency with these regions is negligible. For the liquid-vapor and solid-vapor regions, values are listed at selected temperatures for the bordering condensed phase and vapor boundaries and for selected values of pressure within the regions. Two sets of tables are included for each of these regions. In one set, the values of volume, enthalpy, and entropy are expressed for one pound of phase. In the second set, the values are expressed for one pound of two-phase mixture and a total composition of 50 percent by weight of UDMH. For the vapor region, property values are listed for selected temperatures along the dew point curve, and for temperatures in the superheat region. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N69-16122*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRECISION FLOW MEASUREMENT TECHNIQUES FOR LOW-THRUST AUXILIARY-PROPULSION LIQUID ROCKETS
Daniel J. Grant Washington Jan. 1969 22 p refs
(NASA-TN-D-4785) Avail: CFSTI CSCL 21H

This paper concerns techniques for improving precision in measuring propellant consumption of small (0.5 to 5.0-lbf thrust) rocket engines. By proper use of impeller wheel meters for steady flow and a photometric device for pulsed flow, propellant flow and consumption data accuracies of better than 1% can be achieved. Flow-measurement requirements are considered for both steady and pulsed firing modes, for specific impulses of 150 to 350 seconds, and for oxidizer/fuel ratios from 1 to 2. Frequency standards are used to correlate test-stand data with laboratory calibrations of impeller flowmeters. Fluid dynamic simulation is obtained by selecting inert fluids with kinematic viscosities approximately equal to those of the propellants. Anomalous behavior during calibrations indicates that normal turbine meter frequency-viscosity characteristics are not applicable to impeller-wheel units. The accuracy of the photometric device for pulsed-mode flow measurements depends on fluid meniscus displacement and can provide 99.7% probable range accuracy of $-0.423 \pm 3(0.999)\%$ for a 1.75-inch displacement. The initial models are applicable to a thrust range of 1/2 to 25 lbf. Author

N69-16152*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ON THE DESIGN OF ACOUSTIC LINERS FOR ROCKET ENGINES: MAXIMUM DAMPING AS A DESIGN OBJECTIVE
Bert Phillips Washington Jan. 1969 16 p refs
(NASA-TM-X-1720) Avail: CFSTI CSCL 21H

A study was conducted to determine what the parameters of an acoustic liner should be to maximize liner damping. This was accomplished by solving the wave equation exactly for the frequency and damping of low order tangential and radial modes in a lined cylindrical cavity. The results, presented as dimensionless frequency and damping for each mode plotted in the impedance plane, indicate that α, the acoustic absorption coefficient, can be used to design a liner provided that the liner real impedance is larger than unity. Author

N69-16154*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF SWIRL-CAN TURBOJET COMBUSTORS AT SIMULATED SUPERSONIC COMBUSTOR-INLET CONDITIONS
Helmut F. Butze, Arthur M. Trout, and Harry M. Moyer Washington Jan. 1969 28 p refs
(NASA-TN-D-4998) Avail: CFSTI CSCL 21H

A turbojet combustor comprising an array of swirl cans was evaluated in a rectangular duct at conditions simulating supersonic flight. Tests were conducted at a pressure of 3 atmospheres, inlet-air temperatures of 540° and 1140°F (556 and 889 K), and combustor reference velocities up to 190 feet per second (57.9 m/sec). At combustor-outlet temperatures near 2200°F (1478 K) combustion efficiencies were near 100 percent. At a diffuser-inlet Mach number of 0.3 and an outlet- to inlet-temperature ratio of 2.5, the overall pressure loss was 4.6 percent. At an inlet-air temperature of 1140°F (889 K), temperature rise variation ratios ΔTVR below 1.25 were obtained. Author

N69-16213*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF FLOW RANGE AND STABILITY OF THREE INDUCER-IMPELLER PUMP COMBINATIONS OPERATING IN LIQUID HYDROGEN
Donald C. Urasek Washington Jan. 1969 26 p refs
(NASA-TM-X-1729) Avail: CFSTI CSCL 21H

The effect of inducer-impeller matching on flow range and stability was studied by running three variable lead inducers in combination with a centrifugal impeller. The three inducers were designed for flows of 0.80, 1.00, and 1.20 of impeller design flow. The low flow limit imposed by unstable flow was essentially independent of inducer-impeller matching, whereas the high flow limit imposed by cavitation was improved when the inducer was designed for a higher flow rate than that of the impeller. Author

N69-16392*# Aerojet-General Corp., El Monte, Calif. Space Div.
PROPULSION STUDY FOR SMALL PROBES
J. P. Taylor Jul. 1968 308 p refs
(Contract NAS7-550)
(NASA-CR-99248; FR-9079FR-1) Avail: CFSTI CSCL 21H

An investigation is made into the propulsion requirements of a small rocket motor suitable for future D-region and meteorological sounding applications. A propulsion system concept was established which has a good potential for low unit cost in high production quantities. Three motor concepts are developed. These are: a hybrid unit, a semi-self-pressurizing liquid unit, and a slow burning solid unit. All offer good potential for the stated mission and cost objectives. Additionally, all merit special attention from the standpoint of propulsion technology development. In addition, a fluid power control unit is included. Author

N69-16485*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH AND ADVANCED CONCEPTS
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 120-132 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 21H

Hollow cathode operation in the SE-20C mercury ion thruster continued, with emphasis placed on tests using an adjustable cathode pole piece and baffle assembly. The results indicate that introducing all or a large fraction of the propellant through the cathode may limit utilization and increase discharge losses. Since thruster efficiency depends directly on the characteristics of the discharge plasma a study, using the Langmuir probe, was made to evaluate the efficiency improvements, and the influence of the operating parameters. Figures depict the preliminary results. Investigations continued on the use of liquid-metal magnetohydrodynamic power conversion as a power source for nuclear-electric propulsion. Generator test data are given. Further investigations were conducted on flow visualization as related to the effects of a transverse gas velocity on a glow discharge; the potential distribution within the electrical discharge region was obtained by a probe. It was found that severe distortions of the potential distribution and current distribution, caused by a transverse flow field, introduce significant complexity into theoretical approaches for computing heat transfer to the electrodes. M.G.J.

N69-16585*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESULTS OF RESEARCH ON THE GAS TURBINE LOCOMOTIVE G1-01 AND LOCOMOTIVE GAS TURBINE ENGINES (SELECTED ARTICLES)

4 Dec. 1967 58 p refs Transl. into ENGLISH from Tr. Vses. Nauchn. Issled. Inst. Zheleznodor. Transp. (Moscow), no. 282, 1964 p 14–34; 48–59; 76–83
(AD-678619; FTD-HT-23-1030-67) Avail: CFSTI CSCL 13/6

CONTENTS:

1. RESULTS OF OPERATING TESTS OF THE FIRST DOMESTICALLY PRODUCED G1-01 GAS-TURBINE LOCOMOTIVE M. Ye. Meylikhov et al p 1–24 refs

2. RESULTS OF STAND TESTS OF A GAS-TURBINE ENGINE RATED AT 3500 HP V. M. Sosnovskiy p 25–37

3. EFFECT OF THE VOLUME OF THE SYSTEM ON THE PICKUP OF A TWIN-SHAFT GAS-TURBINE ENGINE Ye. T. Bartosh p 38–46 refs (See N69-16556 06-28)

N69-16556# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EFFECT OF THE VOLUME OF THE SYSTEM ON THE PICKUP OF A TWIN-SHAFT GAS-TURBINE ENGINE
Ye. T. Bartosh *In its* Results of Res. on the Gas Turbine Locomotive G1-01 and Locomotive Gas Turbine Engine (Selected Articles) 4 Dec. 1967 p 38–46 refs (See N69-16588 06-09)
Avail: CFSTI

The present paper deals with the effect of the volume of the regenerator on the pick-up of a twin-shaft engine as an example. Analysis of the derived equations proves that in twin-shaft locomotive engines, regenerators of large volume may impair the pick-up of the engine. Thus, introduction of the regeneration into locomotive gas turbine engines with fixed pick-up may produce increased idling speed of the turbo-compressor and increase of fuel consumption at this speed. This should be taken into account when considering the problem of efficiency and expediency of regeneration in gas turbine locomotives. Author

N69-16671*# Commonwealth Scientific Corp., Alexandria, Va.
DEVELOPMENT AND FABRICATION OF IMPROVED POSITIVE EXPULSION BLADDERS Final Report, 26 Sep. 1967–31 Jul. 1968
Charles R. Brummett and Kenneth J. Johnson 31 Jul. 1968 98 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952091)
(NASA-CR-73606; REPT-68-551) Avail: CFSTI CSCL 21H

The application of chemically vapor deposited aluminum permeation barriers in Teflon-aluminum laminated expulsion bladders was studied. The crystal structure of deposited aluminum was examined to establish the optimum parameters for producing permeation barrier films and, physical properties of chemically vapor deposited aluminum films were investigated to achieve the strength and ductility required for expulsion bladder materials. Teflon-aluminum laminates were produced which exhibited zero permeability to N_2O_4, modulus values below 125 Kpsi and tensile strengths in excess of 4 Kpsi. Interlaminar bond strengths of 5 lb/in/in were achieved. Analysis techniques included emission spectroscopy, optical microscopy, and X-ray diffraction. Highly resolved topographical views of the film surfaces show structures varying from lamellar plates, oriented parallel to the substrate, to columnar structure oriented perpendicular to the substate. The lamellar structure is preferred as a permeation barrier because it offers maximum mean free path through grain boundaries and is also shown to be less affected by deformation stress than the more open structures. Author

N69-16683# Naval Air Propulsion Test Center, Trenton, N. J.
EVALUATION OF THE CONDUCTRON FLAMEOUT SENSOR FOR GAS TURBINE AUTOMATIC RESTART SYSTEM Final Technical Report
James F. Thaler Sep. 1968 34 p
(AD-678757; NAPTC-ATD-155) Avail: CFSTI CSCL 21/5

The Conductron Model 66A001 Flameout Sensor was evaluated under flameout conditions induced by fuel derichment and simulated missile exhaust gas ingestion at sea level, Mach 0.0, 0.5 and 0.8. The Conductron Flameout Sensor satisfactorily observed the presence and absence of flame when the sensor was mounted in the engine spark ignitor opening. The sensor responded rapidly (0.05 seconds) to observed loss of flame and did not give false responses during rapid engine transients. Author (TAB)

N69-16791*# Hughes Research Labs., Malibu, Calif.
ION ENGINE THRUST VECTOR STUDY, PHASE 2 Quarterly Report
G. R. Brewer, K. Amboss, G. Nudd, H. King, R. Seliger et al Dec. 1968 96 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952129)
(NASA-CR-73611; QR-1) Avail: CFSTI CSCL 21C

This report describes the results of the analytical portion of the program to establish the expected degree of thrust misalignment in an electron bombardment ion thruster. The analysis includes the probable misalignment that might occur due to mechanical displacement and time, and its effect on the thrust vector. An analysis of mechanical displacement due to thermal and mechanical stresses on the screen and accel electrodes is presented. An analysis of the design of a thrust stand is presented. The thrust stand is required to complete the second phase, the experimental determination of the thrust with mechanically imposed electrode misalignments. Author

N69-16818# General Electric, Lynn, Mass.
DESIGN AND COMPONENT TEST OF ENGINE AIR INLET PARTICLE SEPARATOR FOR THE CV-7A AIRCRAFT Final Report
R. J. Duffy Ft. Eustis, Va. Army Aviation Mater. Lab. Aug. 1968 79 p refs
(Contract DA-44-177-AMC-343(T))
(AD-678493; USAAVLABS-TR-68-48; TM68AEG1441) Avail: CFSTI CSCL 1/3

An inlet protection system for the CV-7A aircrafts T64-GE-8 engine is described. Separator design, special manufacturing problems, and component test results are presented and discussed. Additional background information describing previous work from which the CV-7A separator design evolved is included where applicable. Component efficiency tests indicate that separator collection efficiencies exceed contract requirements. Pressure loss measurements, taken coincident with the efficiency test, indicate a pressure drop greater than design limits. Engine testing, not included in the modified contract work scope, would be required to accurately define the result of increased pressure loss on installed engine performance. Author (TAB)

N69-16821# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
DESIGN AND EVALUATION OF A HIGH TEMPERATURE RADIAL TURBINE Quarterly Summary Report, 1 Aug.–31 Oct. 1968
G. S. Calvert 16 Nov. 1968 28 p
(Contract DAAJ02-68-C-0003)
(AD-679183; PWA-FR-3022; QSR-5) Avail: CFSTI CSCL 21/5

The detailed designs of the turbine rotor, nozzles, and backplate were completed; and checking of the drawings was started. Mechanical designs of the turbine-test and burner-test configurations were finalized. A contract modification to add a casting development effort to the program was proposed, and the

casting vendor to perform the work was selected. Approximately 85% of the contractor-furnished tests parts were received, and installation of the contractor-furnished test facility was started. Author (TAB)

N69-16894*# Rocket Research Corp., Seattle Wash.
FEASIBILITY INVESTIGATION OF AN INTEGRATED WASTE MANAGEMENT/ROCKET PROPULSION SYSTEM
C. D. Good, E. W. Schmidt, J. E. Mars et al Jan. 1969 204 p refs
(Contract NAS1-6750)
(NASA-CR-66705) Avail: CFSTI CSCL 21H

Waste management propellant performance was successfully demonstrated over a wide range of compositions in a nominal 200-lb-thrust liquid injection type rocket engine. Formulations containing as much as 43 percent feces were found to sustain monopropellant combustion. Theoretical performance calculations were performed over a wide range of waste management propellant compositions. Preliminary studies indicate that combustion chamber temperatures at or below the melting point of aluminum oxide may act as a limiting condition for compositions fired in the monopropellant mode. Propellant formulation studies, physiochemical, safety, and combustion characterization tests were performed. Biological activity tests indicate bacterial growth is definitely inhibited. No degradation of the propellant was observed over a period of 18 months' storage at ambient temperature. Feces samples obtained from a 60-day manned spacecraft simulation experiment were evaluated and were found to possess properties markedly different from feces produced under normal diet and environment. Author

N69-17026*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
SINGLE STAGE EXPERIMENTAL EVALUATION OF VARIABLE GEOMETRY GUIDE VANES AND STATOR BLADING. PART 4: DATA AND PERFORMANCE FOR VARIABLE CAMBER GUIDE VANES AND STATOR B
B. A. Jones and R. P. Oscarson 31 Dec. 1968 192 p refs
(Contract NAS3-7604)
(NASA-CR-54557; PWA-FR-2639) Avail: CFSTI CSCL 21E

A single-stage experimental investigation was conducted to determine the extent that a variable camber inlet guide vane and a two-part stator having adjustable leading and trailing edge metal angles can increase the stable operating range of a compressor front stage. The stage was designed with zero rotor prewhirl at design equivalent rotor speed and 35-degree hub-20-degree tip prewhirl at 70% of design rotor speed (high Mach number cruise conditions). The cruise configuration permitted stable operation at a lower flow for a given speed than those attainable with the SLTO configuration. At cruise rotor speed and flow conditions, the adiabatic efficiency of the cruise configuration was approximately 7% higher than that of the SLTO configuration. (For Part 1 see N68-29854; Part 2, N67-31727; Part 3, N69-14009.) Author

N69-17098*# Dilectrix Corp., Farmingdale, N. Y.
DEVELOPMENT AND FABRICATION OF IMPROVED POSITIVE EXPULSION BLADDERS Final Progress Report
Charles S. Walcer 27 Aug. 1968 53 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952081)
(NASA-CR-73649; JPL-PR-68-550) Avail: CFSTI CSCL 21H

Methods of producing metal foil-Teflon laminates are described. Aluminum and Stainless steel foils were investigated, and 1/2 mil aluminum foil was chosen. Foil treatment and laminate construction are described, and the elimination of blisters was achieved. Codispersions of TFE and FEP were found to improve physical properties. The following properties of the laminates were determined: tensile strength of 2500-2900 psi, 23%-41% elongation, initial moduls of 300 kpsi, and bond strength of 3.5 lb/in/in. N.E.N.

N69-17123*# McGill Univ., Montreal (Quebec). Space Research Inst.
THE DEVELOPMENT OF GUN LAUNCHED ROCKETS
F. M. Groundwater Feb. 1968 148 p refs
(Contract DA-18-001-AMC-7480(X))
(AD-679353; SRI-H-R-6) Avail: CFSTI CSCL 19/1

Basic design concepts for gun boosted rockets are discussed and the launch parameters of the gun examined. The design of the Martlet 3A subcaliber rocket with six-inch motor for launch from the Barbados sixteen-inch gun is described as well as the firing results obtained in the period September 1963 to January 1964. Two successful flights with motor ignition were made with maximum acceleration loadings of 6,500 gs and 3,500 gs respectively. The design of the larger Martlet 3B with an eight-inch motor is described with its test firing series in July 1964. These tests showed that center cavity rocket grains are not suited for gun launched projectiles. The use of end burning rockets or fillers in the center cavity during gun launch is indicated. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N69-16179*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
EARTH REFLECTANCE PATTERNS MEASURED BY RADIOMETER ON HIGH ALTITUDE BALLOON FLIGHTS
Fred L. Bartman Dec. 1968 36 p refs Presented at the Intern. Colloq. on the Util. of Balloons for Sci. Res., Paris, 10-13 Jul. 1967
(Contract NASr-54(03); ORA Proj. 05863)
(NASA-CR-99225; TR-05863-13-T) Avail: CFSTI CSCL 04A

Earth reflectance patterns for 0.55 to 0.75 micron and 0.2 to 5.0 micron solar radiation, measured by radiometer from balloons at 32 to 34 km, are presented and compared with theoretical patterns and other experimental data. The data indicate the spectral dependence and non-isotropic nature of the earth's reflectance. The balloon gondola and instrumentation are described. Author

N69-16820 Oklahoma State Univ., Stillwater.
PERSISTENT AND TRANSIENT ANISOTROPIES OF THE COSMIC RADIATION
Jon Gordon Ables (Ph.D. Thesis) 1967 202 p
Avail: Univ. Microfilms: HC $9.25/MicroFilm $3.00 Order No. 68-8351

Data taken from the world-wide net of cosmic-ray neutron monitors, deep-space probes, and balloon-borne monitors were used to study temporal variations and anisotropies of the cosmic radiation. Analytic methods taken from the fields of the statistical theory of the communication and information theory were adapted for use with the cosmic-ray data. Older methods commonly used in cosmic-ray analyses were expressed in the language of the more modern theory and improvements were suggested; new methods for the normalization of neutron-monitor data were formulated; and a technique for the production of cosmic-ray intensity-contour maps in the time-direction plane from neutron-monitor data was formulated. For the study of rapid variations in the low energy

cosmic-ray flux at high geomagnetic latitudes, a large-aperture balloon-borne cosmic-ray monitoring instrument was constructed and flown at Ft. Churchill, Manitoba, Canada. Dissert. Abstr.

N69-16864# Graduate Research Center of the Southwest, Dallas, Tex.
A PROGRAM TO DETERMINE FUNDAMENTAL NUCLEAR DATA FROM MUON INTENSITY MEASUREMENTS AND TO INVESTIGATE GEOPHYSICAL ASPECTS OF COSMIC RAYS AT HIGH ENERGIES: INITIAL PHASE Final Report
William R. Sheldon Jan. 1969 24 p refs
(Grant AF-AFOSR-1316-67)
(AD-678640; AFOSR-68-2685) Avail: CFSTI CSCL 20/8

A summary is presented of the results of the initial phase of an experimental program to measure absolute directional intensities of cosmic ray muons from energies of a few BeV to approx. 1500 BeV. During this phase of the program an underground muon telescope has been installed in the Mont Blanc tunnel and a magnetic momentum spectrometer has been built at College Station, Texas; both of these instruments are presently in operation. In addition a second magnetic spectrometer has been designed and the construction of this instrument has begun. Other activities include the design of apparatus to transform spark chamber photographic data to a digital format and a review of theoretical calculations of processes which give rise to the muon flux.
Author (TAB)

N69-16951# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ENERGETIC ELECTRONS AT LATITUDES ABOVE THE OUTER ZONE CUTOFF
Alfred L. Vampola Oct. 1968 56 p refs
(Contract F04701-68-C-0200)
(AD-679149; TR-0200(4260-20)-1; SAMSO-TR-68-425) Avail: CFSTI CSCL 4/1

Measurements made by a nine-channel magnetic spectromer (energy range 225 keV to 2.47 MeV) on the polar-orbiting vehicle OV3-3 (1966-70B) indicate that energetic electrons from solar flares have access to the polar zones. Electrons were observed at invariant latitudes above the outer zone cutoff during the periods 29 August to 6 September 1966, 31 January to 8 February and 25 May to 15 June 1967. Isotropic fluxes with no spatial structure were observed over the entire polar zone sampled. Fluxes were independent of altitude over the range of 400 to 4000 km and between 0.13 and 0.48 gauss. Exponential decays of 0.67 and 0.80 days were observed for the 29 August and 2 September 1966 events. Typical spectra could be fit with power law functions with exponents between 3.0 and 3.6 for these two events. The January-February period in 1967 exhibited much harder electron spectra, with an exponential function providing the best fit with E sub o between 285 and 425 keV. Sub-solar and anti-solar polar flux merges with outer zone flux were distinctly different during the early phase of an event.
Author (TAB)

N69-17190# Joint Publications Research Service, Washington, D. C.
THE EARTH'S RADIATION BELTS
S. N. Vernov et al. *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 112-160 refs (See N69-17187 06-34)
Avail: CFSTI

The development of concepts concerning the earth's radiation belts and the experimental methods used for the study of these concepts are discussed. Rocket-borne methods of registering radiation, from the simple gas discharge counter and scintillation counter, to the more complex instrumentation with memory devices, are treated. Also included are descriptions of the first passage through the radiation belts by Luna space probes, and the data gathered as a result of these launchings. Data obtained from the Elektron Satellite flights include information on electron and proton components, and the variations which occur in the belts. Analysis of this data formed the basis for hypotheses on the origin of the radiation belt as a whole, as well as that of inner belt protons, and electrons, low energy protons, and outer belt electrons.
A.C.R.

N69-17191# Joint Publications Research Service, Washington, D. C.
COSMIC RAYS
S. N. Vernov et al. *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 161-187 refs (See N69-17187 06-34)
Avail: CFSTI

The results of cosmic ray investigations in the U.S.S.R. using satellites and automatic space probes are discussed. These studies were conducted in light of the importance of cosmic radiation in the fields of nuclear physics, and astrophysics. The early flights of the Luna probes provided data on the intensity of primary cosmic radiation beyond the limits of the earth's magnetosphere and confirmed concepts concerning the high stability of cosmic rays. Other flights were carried out to study cosmic radiation at low altitudes, in particular to determine the cosmic ray equator. Additional data have been accumulated over the years concerning cosmic ray variations, some observed during the eleven year solar activity cycle. The radial gradient of cosmic variations, as well as intensity bursts of low energy protons, and variations in the area of the moon are also discussed. Cosmic ray studies on the Proton satellites are described.
A.C.R.

N69-17194# Joint Publications Research Service, Washington, D. C.
PLASMA IN INTERPLANETARY SPACE
K. I. Gringauz. *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 307-333 refs (See N69-17187 06-34)
Avail: CFSTI

The development of concepts concerning interplanetary plasma as evolved from spaceborne experiments is discussed, with emphasis on the physical characteristics of plasma and of magnetic fields in the interplanetary medium. As a result of the direct measurements made possible by space flight, existing ideas have been thoroughly re-examined and modified. These measurements in particular led to a decrease in accepted estimates on the concentration of charged particles in interplanetary space at the level of the earth's orbit. The present dynamic model of this plasma is based on theoretical premises, including a series of generalizations of physical phenomena on the sun and in space. These include assumption of the spherical symmetry of the solar corona and the isothermal character of the plasma during its expansion, as well as a quasi-radial solar magnetic field. It is emphasized that long term study of solar plasma streams and its energy spectra should provide the key to broad processes in geophysics and planetary physics; hence, the need for continuing research in this area is justified.
A.C.R.

N69-17195# Joint Publications Research Service, Washington, D. C.
STUDIES OF SHORT-WAVE RADIATION
S. L. Mandelshtan. *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 334-364 refs (See N69-17187 06-34)
Avail: CFSTI

Studies of short wave ultraviolet solar radiation and short wave X-rays are summarized as related to extra-atmospheric investigations of the sun. These studies by the U.S.S.R. correspond to those made by the U.S. and Great Britain, the data from which can be applied to important problems in solar physics and geophysics. It is noted, however, that most collected data pertain to the quiet

sun, although it is known that sporadic active processes cause changes in ultraviolet radiation to a small degree, and in X-radiation, to a greater degree. Optical solar flares occurring in the lower layers of the solar atmosphere have been well covered by astronomical observations from the earth, but bursts of short wave radiation, particularly X-ray flares, have not yet been adequately investigated. These bursts are important in predicting magnetic storms on earth and radio communication disruptions, as well as manned flight safety. Studies of short wave radiation during the course of nonstationary processes are of particular importance. A.C.R.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N69-16165 Michigan Univ., Ann Arbor.
PULSATIONS OF STELLAR ENVELOPES WITH CONVECTION ZONES
Bruce Clayton Cogan (Ph.D. Thesis) 1967 76 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-7576

The role which convection plays in determining the pulsational stability of Cepheid variables is studied. These stars are known to have convection zones in their outer envelopes where hydrogen and helium are being ionized. These regions of ionization are also the regions in which the processes causing instability are located. The linearized pulsation equations are integrated numerically with the variation of the convective flux with the pulsation included. The convective flux is computed in terms of elements rising and falling adiabatically and the variation in the flux is then computed as a function of local quantities and of quantities at the origin of the elements. Using this method of computing the convective flux, the pulsation of the envelope is computed to a depth below the ionization and convection zones. Four models are computed in this study, all having a luminosity of about 2×10^{37} erg/sec and with a range in the logarithm of the effective temperatures from 3.680 to 3.726. Dissert. Abstr.

N69-16185# Universidade Mackenzie, Sao Paulo (Brazil). Grupo de Radioastronomia.
MICROWAVE OBSERVATIONS AND SOME IONOSPHERIC EFFECTS DURING NOVEMBER 12, 1966 TOTAL SOLAR ECLIPSE Final Report, Jun. 1966–Aug. 1966
Pierre Kaufmann Aug. 1968 18 p
(Contract DA-ARO-49-092-66-G/35)
(AD-679212; GRAM-29; REPT-2) Avail: CFSTI CSCL 3/2

Radio observations of the Sun with a 4.28-cm radio polarimeter were performed during the 12 November 1966 total solar eclipse at a site located near the city of Bage, in the extreme south of Brazil. The solar activity during that period is discussed, giving additional data for the eclipse measurements themselves. Author (TAB)

N69-16210*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A COMPUTATIONAL METHOD FOR TIME-OPTIMAL SPACE RENDEZVOUS
Ernest S. Armstrong and Athena T. Markos Washington Jan. 1969 58 p refs
(NASA-TN-D-5017) Avail: CFSTI CSCL 22C

A method is presented for obtaining space rendezvous trajectories between a one stage rocket vehicle and a target in a circular Keplerian orbit. The trajectories satisfy the necessary conditions of the Pontryagin maximum principle for time optimal rendezvous in which no terminal mass constraint is placed on the rocket. The use of Pontryagin's theory leads to a two point boundary value problem. A digital program is given for the iterative solution of this problem. The method is successfully applied for the determination of time optimal rendezvous trajectories between a vehicle launched from the surface of the moon and a target in an 80 nautical mile circular orbit. Author

N69-16308# National Center for Atmospheric Research, Boulder, Colo. High Altitude Observatory.
THERMAL GENERATION OF MAGNETIC FIELDS WITH RADIATION PRESSURE IN ROTATING STARS
S. Kato and Y. Nakagawa [Jan. 1969] 17 p refs
Avail: Issuing Activity

It has been suggested that in rotating stars the electron partial pressure could generate a toroidal magnetic field of a considerable strength. However, recent investigations indicate that the generation of such a toroidal magnetic field could almost completely be suppressed when a weak primodial poloidal magnetic field exists in the star. This paper shows that a toroidal magnetic field of moderate strength could be generated even in the presence of a primodial poloidal magnetic field, if the effect of radiation pressure is taken into consideration. This considered mechanism is effective for moderately massive stars, and a numerical estimate indicates that in A type stars a toroidal magnetic field of the order of thousands of gauss can be generated near the surface within the time scale of the evolution of the star. Author

N69-16472*# Bellcomm Inc., Washington, D. C.
COLLISIONAL MODEL OF ASTEROIDS AND THEIR DEBRIS
J. S. Dohnanyi 22 Jul. 1968 61 p refs
(Contract NASw-417)
(NASA-CR-99280; TR-68-710-4) Avail: CFSTI CSCL 03C

A model for colliding objects in the asteroidal belt is formulated. An integro-differential equation describing the evolution of a system of particles undergoing inelastic collisions and fragmentation is derived and solved for steady state conditions. It is found that the number density of particles per unit volume in the mass range m to m + dm is $Am^{-\alpha}dm$ where A and α are constants (provided that certain conditions are satisfied). The population index α can then be derived theoretically; for asteroids and their debris, $\alpha = 1.837$, in agreement with an empirical fit to the observed distribution. Various statistical properties of the distribution can be derived from the model. It is found that, for asteroidal objects, catastrophic collisions constitute the most important physical process determining particle lifetimes and the form of the particle distribution for particles sufficiently large that radiation effects are unimportant. Author

N69-16476*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEMS ANALYSIS RESEARCH
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 1-15 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 03B

For the ephemeris development activity, the radar data set was revised to reflect the current available information, and a new determination of the mass of Mercury was made. A simplified method of variation of parameters (variation of arbitrary constants) is described. The method uses a fixed Keplerian reference orbit, but no osculating orbits or osculating orbit elements; six similar first-order differential equations are also obtained. The problems

involved in the optimization of a solar electric propulsion (SEP) planetary orbiter spacecraft are discussed. A two-body optimization of the trajectory of a thrusting SEP low-thrust spacecraft is presented, which simultaneously solves the equations of motion and the variational equations. An asymptotic velocity bias method is used to account for the effects of the departure and arrival planets on the performance estimates to be obtained. The equations for spherical harmonic expansion of mascons are derived and applied to a preliminary moon model. M.G.J.

N69-16478*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ENVIRONMENTAL REQUIREMENTS
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 22-29 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 03B

Six engineering models of the Venus atmosphere are proposed for space vehicle design based on a theoretical Venus thermal model, and on data from Mariner 5 and Venera 4 space probes. The models describe profiles for temperature, density, pressure, speed of sound, molecular mass, density scale height, number density, mean free path, and viscosity. These parameters were calculated by numerical integration of the hydrostatic equation with the aid of thermodynamic relationships. Figures depict the temperature and density profiles for each model. Atmospheric environmental interactions with the principal space vehicle subsystems are summarized, and the atmospheric parameters involved in each case are identified. The application of thermal modeling to space vehicle sterilization is discussed in terms of geometric and analytic capsule models. These models were developed to (1) provide insight into the relationships existing between the characteristics of the microbial populations and the thermal characteristics of the space vehicle and heating medium, and (2) perform sensitivity studies prior to subjecting the hardware to a sterilization environment. M.G.J.

N69-16482*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLIED MECHANICS
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 79-90 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 22C

For the simulation of Venus atmospheric entry by earth reentry, time histories of acceleration, angle of attack envelope, entry heating, and heat shield ablator response were calculated at two locations on a spherically blunted, 60° half-angle conical body. This was done to determine the best match of path angles and the degree of simulation attainable for the four factors specified. It was concluded that a full-scale vertical earth reentry flight test at the same ballistic coefficient and entry velocity should provide an acceptable simulation of deceleration, dynamic motion, and heat shield response at a Venus path angle of about 45° despite significant differences in radiative heating. An outline is presented on the basic theoretical concepts and analysis being used to determine the bearing capacity and the pressure-sinkage relationships of soft soil surfaces when subjected to uniform vertical or inclined loads. Objectives are defined for an exploratory test program which is being conducted to disclose the soil failure character and response (load versus displacement) of the horizontal soil surface and the sloping soil surface. M.G.J.

N69-16507*# Bellcomm, Inc., Washington, D. C.
HAZE IN THE MARS ATMOSPHERE AS REVEALED BY THE MARINER 4 TELEVISION DATA
P. L. Chandeysson, E. N. Shipley, and W. S. Thompson 20 Aug. 1968 43 p refs
(Contract NASw-417)
(NASA-CR-99262; TR-68-710-6) Avail: CFSTI CSCL 22A

A photometric model for Mars has been developed which explains all the relevant features of the Mariner IV television data. The dominant feature of the model is a haze component in the atmosphere which substantially affects the overall scene brightness. The model can be used to subtract the haze effect from available pictures or to compute scene brightness in geometries different from those of Mariner 4. Author

N69-16571*# National Aeronautics and Space Administration, Washington, D. C.
THE BOOK OF MARS
Samuel Glasstone 1968 315 p refs
(NASA-SP-179) Avail: SOD $5.25 CSCL 03

This book contains information about Mars, gained over a period of years by many scientists throughout the world, from the use of sensitive instruments and theoretical evaluation. The possibility of life on Mars is analyzed and guidelines for avoidance of Mars contamination during spacecraft exploration of the planet are included. G.G.

N69-16581# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVIATION OF THE APPARENT TRACK OF A SATELLITE ON THE CELESTIAL SPHERE FROM THE ARC OF A GREAT CIRCLE FOR THE CASE OF A CIRCULAR ORBIT
V. I. Belenko *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38 14 Feb. 1968 p 30-32 (See N69-16574 06-14)
Avail: CFSTI

A formula describing the deviation of the apparent path of a satellite moving on a circular orbit from the arc of a great circle is derived. Author

N69-16582# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVIATION OF THE APPARENT SATELLITE ORBIT FROM THE ARC OF A GREAT CIRCLE
G. A. Leykin *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38 14 Feb. 1968 p 33-36 (See N69-16574 06-14)
Avail: CFSTI

A formula describing the deviation of the apparent path of a satellite moving on a circular orbit from the arc of a great circle was derived. Author

N69-16583# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRELIMINARY ORBITAL ELEMENTS OF ARTIFICIAL EARTH SATELLITES COSMOS 2, COSMOS 3, AND COSMOS 5
G. A. Chebotarev et al. *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, No. 38 14 Feb. 1968 p 37-39 refs (See N69-16574 06-14)
Avail: CFSTI

The initial orbital elements of Cosmos 2, 3, and 5 satellites are tabulated based on an improved method. The semimajor axis of the satellite orbit is expressed in equatorial radii of the earth (R_e = 6378.15 km). Mean elements of the orbit at any moment are calculated by specified formulas. Author

N69-16584# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRELIMINARY MEAN ORBITAL ELEMENTS OF THE CABIN OF THE FIRST SOVIET SPACE SHIP (1960 ϵ_3) FOR JANUARY-JUNE 1963

G. A. Chebotarev et al *In its* Bull. of the Sta. for Opt. Observations of Artificial Earth Satellites, no. 38 14 Feb. 1968 p 40-41 (See N69-16574 06-14)

Avail: CFSTI

Preliminary mean orbital elements of the cabin of the first Soviet spaceship are given. Equatorial elements and secular perturbations are given for the period of January-June 1963. Author

N69-16691*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GRAVITY HARMONICS FROM A RESONANT TWO-HOUR SATELLITE

James P. Murphy and Isabella J. Cole Dec. 1968 14 p refs

(NASA-TM-X-63439; X-552-68-493) Avail: CFSTI CSCL 22C

The semimajor axis of an artificial satellite can undergo long term variations if its mean motion and the rotational speed of the earth are nearly commensurable. A theoretical expression for this variation is obtained for satellites with a 12 to 1 such commensurability by considering twelfth order harmonics of degree 12 through 15. The TIROS 9 satellite is in such a near resonant orbit. From this single satellite, only two pairs of resonant gravity harmonics of twelfth order can be estimated. One pair must be of even degree while the other is of odd degree. The values obtained must be considered to be in some sense composite harmonics since all harmonics whose order is divisible by 12 are nearly resonant. These values will however serve as estimates with widest application to orbit prediction for satellites with orbit characteristics similar to those of TIROS 9. Author

N69-16729# Mitre Corp., Bedford, Mass.

THE MODIFIED SPACE-A TRAJECTORY GENERATION PROGRAM

William L. Wallace and Richard H. Wiggins, Jr. Nov. 1968 161 p refs

(Contract AF 19(628)-5165)

(AD-678870; MTR-733; ESD-TR-68-288) Avail: CFSTI CSCL 22/3

This report describes the SPACE-A program presently available for operational use. SPACE-A is the trajectory and observation generation portion of the Sequential Position and Covariance Estimation Program (SPACE) which is currently under development. The document contains a detailed analysis of the equations and models used by the program, a brief description of routines used in the program, as well as instructions for its operations. The principal applications of SPACE-A are the prediction of the space-vehicle trajectories and the generation of observational data plus other trajectory related information. Author (TAB)

N69-16742 Indiana Univ., Bloomington.

MODEL ATMOSPHERES FOR HELIUM STARS

Daniel Alexander Klinglesmith, III (Ph.D. Thesis) 1967 237 p

Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-2310

Twenty four model atmospheres for helium stars have been constructed in an effective temperature range of 16,000°K to 30,000°K and a surface gravity range of log g = 2.5 to log g = 4.0. Two sets of models were constructed, one was pure helium (Y = 1.0, X = 0.0); the other was a mixture of helium and hydrogen (Y = 0.999, X = 0.001). Opacity sources and techniques used to compute the models are discussed. The observable properties of the emergent energy distribution for each model (emergent flux, UBV colors, discontinuities, and bolometric corrections) are presented and discussed. Concerning the models themselves, the run of pressure as a function of temperature is steeper and the emergent fluxes have more energy in the ultraviolet due to the lack of hydrogen opacity than model atmospheres with normal composition. Dissert. Abstr.

N69-16743 Illinois Univ., Urbana.

POPULATION DISCRIMINATION AMONG PLANETARY NEBULAE

William Elliott Greig (Ph.D. Thesis) 1967 99 p

Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-8092

Planetary nebulae are divided into the morphological types: B for bi-nebulous such as the Dumbbell nebula, C for circularly symmetric nebulae such as the double ring NGC 7662, A for annular and a very few miscellaneous. It is shown that B nebulae belong to intermediate population I which means that they are rather young objects in the Galaxy. In contrast to this, non-B nebulae belong to an old population. Previous to this work it was assumed that all planetary nebulae, with few if any exceptions, were rather old. B nebulae exhibit strong [N II], [O II] and [O I]. The line intensity ratios $[N\ II]/H_n \geq 0.4$ and $[O\ II]/H_\beta \geq 0.7$ are satisfied. Indeed the line intensities are used as supplemental classification criteria where the morphological type is indefinite. In C nebulae these line ratios are smaller by an average factor of 5. Dissert. Abstr.

N69-16881# California Univ., La Jolla. Dept. of Applied Electrophysics.

HIGH RESOLUTION STUDIES OF DISCRETE RADIO SOURCES Final Report, 1 Feb. 1967-31 Aug. 1968

M. H. Cohen Sep. 1968 12 p refs

(Grant AF-AFOSR-1260-67)

(AD-678601; AFOSR-68-1925) Avail: CFSTI CSCL 3/2

Grant AF-AFOSR-1260-67 was received on 1 February 1967 and terminated on 31 August 1968. The main objective was to make diameter and structure measurements on compact radio sources. Two techniques, both in the process of development, were employed: interplanetary scintillations, and very-long-baseline interferometry using independent local oscillators. TAB

N69-16892* Houston Univ., Tex. Cullen College of Engineering.

SIMULATED LM STATIC REFLECTIVITY DATA, FOR SITE P-2-6

H. S. Hayre, A. Tong, and R. A. Meador Nov. 1967 36 p refs

(Contract NAS9-6780)

(NASA-CR-92483; TR-67-21) Avail: CFSTI CSCL 22B

A brief discussion of the LM acoustic simulation system and procedures used in taking static reflectivity data is given. A total of thirty points along the landing trajectory were selected for this data. The reflected field was plotted in dbs versus incident angles for quick reference. Author

N69-16907* Technische Hochschule Stuttgart (West Germany). Arbeitsgemeinschaft fuer Raketentechnik und Raumfahrt.

FUEL OPTIMAL GUIDANCE LAW FOR SPACE VEHICLES AND ITS APPLICATION TO SOFT LANDING ON THE MOON (REVISED) [MASSENVERBRAUCHSOPTIMALES STEUERGESETZ FUER RAUMFAHRZEUGE UND SEINE ANWENDUNG AUF DIE WEICHE LANDUNG AUF DEM MOND]

Lutz T. Kayser Jul. 1968 61 p refs In GERMAN Previously N68-31893

(AGRR-TB-10) Avail: CFSTI CSCL 22C

Details are given on a fuel optimal guidance law for space vehicles that defines amount and direction of the thrust vector as a function of the state variables. A sample integration of a soft moon landing using the guidance subroutine is included. A 1% increase in payload was demonstrated against a gravity turn landing. Author

N69-16917*# Stanford Univ., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semiannual Status Report, 1 Jul.–31 Dec. 1968
Jan. 1969 18 p refs
(Grant NGL-05-020-014)
(NASA-CR-73653; SaSR-12) Avail: CFSTI CSCL 03

The following project plans and accomplishments are reviewed: (1) comparisons of Venera 4 and Mariner 5 data on Venus lower atmosphere; (2) reduction of Mariner 5 differential Doppler and amplitude data on ionospheric electron density and temperature and pressure profiles for the Venutian atmosphere; (3) simulation of the Martian atmosphere; (4) feasibility of measuring starlight bending from an orbiting spacecraft; and (5) experimental packaging for the Mariner Mars 1971 orbiters. Progress summaries for graduate student investigations are included. E.C.

N69-16940# Office of Naval Intelligence, Washington, D. C. Translation Div.
THE REDUCTION OF MERIDIAN OBSERVATIONS INCLUDING THE RESULTS FROM OBSERVATIONS OF THE STARS UNDER DETERMINATION [ORRABOTKA MERIDIANNYKH NABLYUDENIY S PRIVLECHENIYEM REZUL'TATOV NABLYUDENIY OPREDELYAYEMYKH ZVEZD]
V. V. Konin 5 Sep. 1968 20 p refs Transl. into ENGLISH from Izv. Glavnoi Astron. Observ. (Pulkovo), no. 181, 1966 p 70–79
(AD-679321; NIC-Trans-2688) Avail: CFSTI CSCL 3/1

The question of an increase in the accuracy of the results of meridian determinations of stellar coordinates is discussed with the aid of a reduction in two approximations of the data obtained. The possibility of applying the provisional mean coordinates of the stars under determination toward this end is demonstrated. The conditions are formulated which, mean satisfied, guarantee the maximum effectiveness of the reduction of the observational data according to the method discussed. Author (TAB)

N69-17029# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE DEPARTMENT OF DEFENSE SELENODETIC CONTROL SYSTEM AND THE FORCE FUNCTION OF THE MOON
C. L. Goudas Oct. 1968 50 p refs *Its* Math. Note 578
(AD-678977; D1-82-0766) Avail: CFSTI CSCL 3/2

The Figure of the Moon as defined by the DOD-66 Selenodetic Control System is first studied. Then, using the derived equation for the surface and adopting the density law delta = delta sub c + alpha times (rho to the p power), the volume integrals relating the surface to the gravity harmonics are computed. Author (TAB)

N69-17058*# Techrsn Corp., Glen Burnie, Md.
MINERALOGICAL INVESTIGATION OF THE LANCE CHONDRITE C III. COMPARISON WITH OTHER METEORITES OF THE SAME GROUP [ETUDE MINERALOGIQUE DE LA CHONDRITE C III DE LANCE. COMPARAISON AVEC D'AUTRES METEORITES DU MEME GROUPE]
C. Michel-Levy Washington NASA Oct. 1968 Transl. into ENGLISH from a French paper Presented at Intern. Colloq. on Res. Concerning Meteorites, 7–13 Aug. 1968
(Contract NASw-1695)
(NASA-TT-F-11986) Avail: CFSTI CSCL 03B

The Lance meteorite contains two basic formations: (1) Chondri and heterogeneous crystalline fragments which have undergone no modification since their deposit are present. These fragments contain olivine of a variable composition, clinipyroxene, spinel, melilite, and metallic ores. Many olivine grains contain gaseous inclusions, and some chondri have retained a trace of previous recrystallization. Other fine grained fragments are formed of olivine, pyroxenes, and occasionally spinel. (2) A very fine matrix is also found, which is rich in olivine, as studied by electronic microprobes and X rays. It may have reached its present condition at very moderate temperatures. The Lance meteorite is compared with other carbonaceous meteorites, all of which contain microcrystalline olivine rich in iron. Author

N69-17113# Army Biological Labs., Fort Detrick, Md.
AT THE INTERNATIONAL ASTRONOMICAL UNION
A. A. Mikhailov Jul. 1968 5 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), v. 31, no. 12, Dec. 1961 p 94–97
(AD-678921; TRANS-1098) Avail: CFSTI CSCL 3/1

An overview is presented on the conference papers pertaining to various branches of astronomy, and on scientific collaboration and international cooperation in solving complex problems. Opposition to launching minute metallic needles into space was voiced, and Soviet resistance to conducting such experiments without consultation is stated. The participation of Soviet scientists in the conference is discussed, and the position and relative standing of Soviet astronomy are extolled. M.G.J.

N69-17114 Maryland Univ., College Park. Dept. of Physics and Astronomy.
CRATERING AND THE MOON'S SURFACE
E. J. Oepik [1968] 378 p refs
(Grant NsG-58-60)
(NASA-CR-99212) Avail: CFSTI CSCL 03B

A mechanical and statistical analysis of the lunar surface and its evolution is presented. Impact cratering and erosion are the prevailing factors shaping the lunar surface. Impact melting produced the lava flows of the maria at an early stage. No traces of contemporary orogeny or volvanism are indicated. Cratering formulas are proposed based on projectile momentum and target strength. Formulas are also given for the encounter probabilities, lifetimes, and statistical accelerations of particles in planetary encounters with emphasis on small relative velocities. The problems of the origin of the moon are analyzed with the help of the theories of cratering and planetary encounters. The formation of a mare is explained by impact melting of a hot crust in a cratering collision. A minimum survival limit of about 300 meters diameter against erosion is suggested. The top layer of soil consists of a heterogeneous mixture of particles of a broad distribution of sizes. The mechanical properties of lunar soil are similar to those of terrestrial sand. Author

N69-17193# Joint Publications Research Service, Washington, D. C.
LUNAR STUDIES
A. A. Mikhaylov *et al* *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 274–306 refs (See N69-17187 06-34)
Avail: CFSTI

A chronology of Soviet lunar studies, from the astronomical and radioastronomical methods to investigations using modern

space technology, is presented. The two stage development of rocket-space systems for this purpose is emphasized. Early flights were conducted to test the various rocket systems, as well as to gather scientific information. The first photograph of the moon's far side was obtained by the Luna 3 probe, from which a diagrammatic map of the far side was constructed. Other photographs were obtained on surface morphology, and distribution of seas and continents, but the failure to bring instruments into contact with the surface created many problems, both in the U.S. and U.S.S.R. The second stage of development solved this problem, so that instruments could be placed on the surface or in circum-lunar orbit. More complex trajectories, soft landings, and more refined instruments, including improved television equipment, and physical and mechanical digging mechanisms, have enabled determination of the structural surface features and mineralogical composition of the moon on an accurate and minute basis. A.C.R.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N69-16155*# Measurement Analysis Corp., Los Angeles, Calif.
A METHOD FOR PREDICTING LAUNCH VEHICLE VIBRATION LEVELS IN THE REGION OF THE SPACECRAFT ADAPTOR
A. G. Piersol and W. F. Van Der Laan. Washington NASA Jan. 1969 115 p refs
(Contract NAS1-7490)
(NASA-CR-1227; MAC-709-10) Avail: CFSTI CSCL 22D

This report derives and presents a set of prediction curves for launch vehicle vibration levels in the region of the spacecraft adaptor structure. The prediction curves are developed by a regression analysis of previous data collected for various different launch vehicle configurations, and are based upon six rudimentary parameters describing the launch vehicle flight and propulsion conditions. The intent is to provide a basis for making preliminary vibration predictions early in the conceptual design of a new launch vehicle configuration so that test specifications and design criteria can be established for the procurement of long lead time equipment items. The predictions are presented in terms of average power spectral densities in octave band frequency intervals for liftoff transonic flight, and maximum dynamic pressure flight. All data used to arrive at the prediction curves are presented, and the efficiency of the curves is fully evaluated. Author

N69-16221*# Ling-Temco-Vought, Inc., Dallas, Tex.
ROLL AND YAW COMPENSATION FEASIBILITY STUDY
P. D. Fremming. Washington NASA Jan. 1969 113 p refs
(Contract NAS1-5592)
(NASA-CR-1209; REPT-3-32000/7R-38) Avail: CFSTI CSCL 22D

The feasibility of using roll and yaw compensation to reduce the inclination error of the Scout launch vehicle was investigated. The recommended circuit configuration, a discussion of the recommended checkout method and equipment, and a description of the installation requirements are included. From the analyses, it was concluded that a pre-programmed type of multiplier is the only system currently known to have sufficient accuracy to meet the requirements of roll and yaw compensation. Analysis showed that a gyro drift rate caused by the compensation unit of greater than 0.5 degrees per hour degrades the inclination accuracy improvements realized by the addition of the roll and yaw compensation. Since a steady voltage across the gyro torquer produces a drift rate, it is concluded that the null uncertainty of the compensation unit must be less than 0.0002 volts to meet the drift requirements. Only the pre-programmed multiplier can meet this null requirement. This device achieves the required multiplication by changing the gain of the compensator as a function of the pitch program rate on command from the Intervalometer. Author

N69-16250# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A NEW STAGE IN THE CONQUEST OF SPACE. BRILLIANT EXPERIMENT SEES AUTOMATIC DOCKING OF TWO SPACECRAFT IN ORBIT
6 Dec. 1967 8 p Transl. into ENGLISH from Pravda (Moscow), 1 Nov. 1967 p 3
(AD-678789; FTD-HT-23-1606-67) Avail: CFSTI CSCL 22/2

On 30 October 1967, the Soviet Union carried out a new space experiment. For the first time two orbiting automatic artificial geocentric satellites, Kosmos-186 and Kosmos-188, were docked without human intervention. Author (TAB)

N69-16474# Forsvarets Forskningsanstalt, Stockholm (Sweden).
BASIC STUDIES OF BALLISTIC PROJECTILES WITH BOOSTER PROPELLANT, REPORT NO. I, STATUS OF WORK 1 JULY 1966 [GRUNDLAEGGANDE STUDIER BETRAEFFANDE REATILER, RAPPORT NR. I AVSEENDE ARBETSLAEGE 1.7. 1966]
S. Broddner and A. Magnusson Sep. 1967 115 p In SWEDISH
(A-2493-46) Avail: CFSTI

Study of the formation and behavior of the booster charge was emphasized, since the stresses on the booster charge in this type of projectile are an order of magnitude greater than in conventional rockets. The existing applicable literature was reviewed. External ballistics and stresses caused by rotation and acceleration were calculated. One test installation was constructed for studying booster charge deformations at up to 15,000 rpm, for determining effects on the internal ballistics, and for measuring pressure effects on combustion. Another test facility permits acceleration of the charge up to 15,000 g. K.W.

N69-16479*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT POWER
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 30-60 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 22B

As part of the solar power system definition studies, a FORTRAN 4 computer program was developed for predicting battery discharge characteristics. Experimental data, at a constant discharge current are fitted by the program to an empirical equation which describes the battery potential during discharge as a function of discharge time, current density, and other factors. An overview is presented on contractor efforts to develop optimum power systems for both Mars flyby and orbiter spacecraft, and to investigate the characteristics of solar cell contacts as a function of exposure to various environments. Interagency cooperation in solar cell standardization is discussed, and solar cell calibration is described. Three deployment mechanism concepts are proposed for the 30 W/lb solar cell power system, and a non-oriented conical truncated cone design was selected for a solar array on the soft lander capsule. A coulometric potentiostatic method of electrode area determination is reported, along with X-ray radiographic studies of Mariner-type battery cells, calorimetric measurements on the Surveyor main battery, designs for a six-converter solar thermionic generator and boost regulator, and the power requirements for an electric propulsion power conditioner unit. M.G.J.

N69-16480*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT CONTROL
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 61-67 refs (See N69-16475 06-07)
Avail: CFSTI CSCL 22B

As part of the partial inertial system intergration test, the LAB 1 Alert program was exercised during integration of the strapdown electrostatic aerospace navigator system. The test set-up is described, and the results of a 52.266 -min test without altimeter damping, and a 26.133 min test with damping are tabulated. Several improvements are reported in the development of an automatic lens design, such as changes in the computer program, a method of handling a curved image plane, and a technique for controlling image contrast. Data are included on the vibration and shock analyses which were conducted to (1) determine the g level that could be transmitted through various combinations of natural frequency and damping ratios of a mechanical system which would be detrimental to the survival of the electrostatic gyroscope, and (2) determine the minimum parameters that would isolate the destructive g input. M.G.J.

N69-16487*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENCE DATA SYSTEMS
In its Supporting Res. and Advanced Develop. 31 Oct. 1968 p 144-148 (See N69-16475 06-07)
Avail: CFSTI CSCL 22B

Shock tests were performed on two subassemblies of the Mariner Venus 67 prototype data automation subsystem to provide information on the ability of the multilayer board packaging of these subassemblies to withstand shock levels beyond those for which it had been designed. Drop test and slingshot test conditions are described. Two modifications are recommended to enable the subassembly to withstand shock at the 4525 g level. M.G.J.

N69-16505*# Bellcomm, Inc., Washington, D. C.
STABILITY OF ATTITUDE MOTION OF AN ORBITING VEHICLE CONTAINING A GYROSTAT
E. Y. Yu 30 Sep. 1968 24 p refs
(Contract NASw-417)
(NASA-CR-99264; TM-68-1022-8) Avail: CFSTI CSCL 22B

A study is made on the stability of equilibrium attitude of a space vehicle containing a gyrostat with respect to the earth-pointing rotating frame in a circular orbit. Based on the first approximation stability analysis incorporated with damping, criteria for asymptotic stability are obtained for a few equilibrium attitudes in which the gyrostat is oriented normal to the orbital plane. One interesting result is that the attitude configuration with the axis of minimum moment of inertia being the axis of rotation, which is asymptotically unstable in the classical case, can be made asymptotically stable by the gyrostat. Author

N69-16738*# Martin Co., Denver, Colo.
DEVELOPMENT OF THE STERILE INSERTION HEAT SEALING TOOL AND PORT OPENING Final Report, 7 May 1968-31 Jan. 1969
31 Jan. 1969 105 p refs
(Contract NAS5-11133)
(NASA-CR-73609; MCR-68-527) Avail: CFSTI CSCL 22B

As part of a continuing NASA-sponsored program to develop a methodology for sterile operations on unmanned planetary spacecraft, a self-propelled, operator-free heat sealing tool and corresponding port opening were designed and fabricated. Concurrently, a method was developed to form large plastic barriers of FEP film to the shape of the port opening. Inspection of the above hardware showed no adverse effects after exposure to ethylene oxide decontamination and dry heat sterilization at 125°C. Development testing established operating parameters to obtain acceptable seams of the plastic film barriers with the heat sealing tool. Author

N69-16807*# White Sands Missile Range, N. Mex. Atmospheric Sciences Research Office.
METEOROLOGICAL RESEARCH, DEVELOPMENT, TEST AND EVALUATION ROCKET
Kenneth R. Jenkins Sep. 1968 38 p refs
(AD-679026; ECOM-5215) Avail: CFSTI CSCL 19/7

A description of a prototype U. S. Army meteorological rocket vehicle designed for systematic research and range support soundings is presented, including configuration, performance, cost and design criteria. Informal estimates of the utilization rate of the new vehicle by various U. S. Government agencies are presented. U. S. Army requirements for meteorological data in the stratosphere and mesosphere are set forth. Author (TAB)

N69-16813*# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
DESIGN OF THE ROTATIONAL KINETIC ENERGY DISSIPATION SYSTEM FOR URE SATELLITE WRESAT 1
D. J. Baines Sep. 1968 59 p refs
(HSA-134) Avail: CFSTI

The fluid loop energy dissipator fitted to the Weapons Research Establishment satellite, WRESAT 1, to ensure adequately fast attainment of the stable spin condition is described. Two theories giving the rate of dissipation of energy in terms of geometrical properties of the loop and physical properties of the fluid are presented. One is a simple analysis based on consideration of the mean cross-sectional flow within the tube, whereas the second is derived from the equation of laminar pipe flow and takes account of the variation in fluid velocity in the plane of the cross-section. Theoretical predictions of dissipator performance are compared with experimental measurements made with the dissipator in free oscillation as a compound pendulum, and with telemetry measurements from WRESAT I during its first orbit. Author

N69-16850*# Library of Congress, Washington, D. C. Aerospace Technology Div.
SPACECRAFT UTILIZING THE LIFTING AND BALLISTIC REENTRY TECHNIQUE. REVIEW OF THEORETICAL STUDIES IN LIFTING AND BALLISTIC REENTRY Surveys of Foreign Scientific and Technical Literature
A. Barstoff and V. Klein 13 Dec. 1968 178 p refs *Its* Ser. Rept. no. 4
(ATD-68-59-52-1) Avail: Issuing Activity

The report consists of two sections: an analytical survey of papers published in foreign scientific sources, and an annotated bibliography from which all the reviewed papers were selected. The papers are divided into the following principal groups: (1) high-speed aerodynamics and gas dynamics, including rarefied gas flow and design of minimum-drag bodies; (2) high-speed aerothermodynamics, including kinetic heating, injection cooling, and ablation shielding; and (3) high-speed flight mechanics, including spacecraft motion and control, ballistic and powered flight trajectories, and meteorite hazards. The articles and monographs selected for review have an especially close relation to the problems of lifting and ballistic reentries and show either an original approach or propose a new method or technique of experimental investigation. K.W.

N69-16915*# Volt Information Sciences, Inc., Washington, D. C.
PRESS CONFERENCE ON THE FLIGHT OF SPACESHIPS SOYUZ-4 AND SOYUZ-5

Greenbelt Md. NASA. Goddard Space Flight Center 30 Jan. 1969 11 p Transl. into ENGLISH from Pravda (Moscow), no. 25, (18438), 25 Jan. 1969
(Contract NAS5-12487)
(NASA-CR-73752; HL-PR-10803) Avail: CFSTI CSCL 22A

A Soviet press conference on the flight of spaceships Soyuz-4 and Soyuz-5 was held for Soviet and foreign newsmen on 25 January 1969 at the Assembly Hall of the Moscow State University. The press conference was devoted fully to the successful docking of the two manned spacecraft, the transfer of the two cosmonauts from one spacecraft to the other, and speeches by the cosmonauts. The cosmonauts were introduced by the President of the USSR Academy of Sciences and were awarded gold medals for their achievements. Following speeches by each of the cosmonauts, the news conference was opened to a question and answer period.
A.L.

N69-16957*# Lockheed Missiles and Space Co., Palo Alto, Calif.
THERMAL AND STRUCTURAL MODELING OF A LARGE APERTURE SPACE TELESCOPE Technical Summary Report, 22 Jun. -22 Sep. 1968
R. E. Rolling, K. N. Marshall, and D. O. Murray Nov. 1968 293 p refs
(Contract NAS8-20411)
(NASA-CR-98241) Avail: CFSTI CSCL 22B

Major conclusions reached during analytical and experimental work on thermal and structural modeling for a two meter aperture telescope are reported. A thermal analyzer program to predict flight performance found passive thermal control techniques sufficient to provide absolute temperature levels and to reduce temperature differences in the primary mirror to ±1°K. A multilayer high performance insulation model, consisting of aluminized mylar and dexiglass, was constructed and evaluated under steady state and transient conditions and was then modeled to half scale under similar conditions. It was found that a model design having a length scale ratio of 1/6.43 and an absolute temperature ratio of 1/1.86 was feasible. The model was constructed and tested under simulated synchronous orbit and compared favorable with analytical predictions.
G.G.

N69-17125# Boeing Co., Seattle, Wash. Office of International Operations.
SPACE TECHNOLOGY AND SPACE RESEARCH IN THE FEDERAL REPUBLIC OF GERMANY
Werner Mueller Dec. 1968 27 p Transl. into ENGLISH from Flug Rev. (Germany), no. 5, 1968 p 50
Avail: Issuing Activity

The direction of Germany's space program is discussed from the viewpoints of direct application of space research in economic utilization particularly in satellite programs, and the numerous technological findings which benefit the economy indirectly. Participation in ESRO, ELDO, and CETS is related, and the difficulties involved in funding are recounted. Details are given on the medium-term program for promotion of space research from 1967 to 1971, and it is pointed out that appropriations for the national program are considerably above the expenditures earmarked for international commitments. The shift in emphasis from aviation technology to space technology is reported, along with the trend toward formation of special company groups and the merger of independent companies into larger and technically stronger units.
M.G.J.

N69-17199# Joint Publications Research Service, Washington, D. C.
SOVIET ARTIFICIAL EARTH SATELLITES, SPACECRAFT AND THEIR TECHNICAL CHARACTERISTICS. APPENDIX
V. V. Bazykin *In its* USSR Achievements in Space Res. 21 Jan. 1969 p 511-615 (See N69-17187 08-34)
Avail: CFSTI

Tabulated data are included for the Soviet satellites and spacecraft launched between 1957 and 1967. Launch, orbit, and altitude information is given, as well as the present status of the vehicle. A discussion follows on the technical characteristics, scientific experiments, and flight performance for each of the principal space systems during that period. Included are the Kosmos, Polet, Elektron, Proton, and Molniya satellite series, and the spaceship-satellites developed for manned space flight missions: Vostok, Voskhod, and Soyuz. The Luna series of lunar probes; the automatic Venus probes in the Venera series; the Mars probes; and the Zond interplanetary probes are also included in the summary.
A.C.R.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter, inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N69-16114*# Case Western Reserve Univ., Cleveland, Ohio.
THE STRUCTURAL SYNTHESIS OF AN ABLATING THERMOSTRUCTURAL PANEL
William A. Thornton and Lucien A. Schmit, Jr. Washington NASA Dec. 1968 205 p refs
(Grant NsG-110-61)
(NASA-CR-1215) Avail: CFSTI CSCL 22B

The development of a structural synthesis capability for ablating thermostructural panels in a planetary entry environment is reported. The synthesis utilizes a penalty function technique in conjunction with integrated behavior constraints. The thermal analysis includes the effects of surface recession and pyrolysis gas transpiration. The ablator layer is structural. Design variables are the layer thicknesses and panel size. Behavior constraints are the temperature at the ablator-structure interface and at the backwall, panel deflection, ablator stress, structural layer stress, intercell face buckling, and char strain. The synthesis will minimize panel weight or panel thickness. The results of 12 test cases are presented. It is found that the usual a priori assumptions about the panel thermal profiles required for minimum weight designs are not justified.
Author

N69-16115*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
A DIGITAL COMPUTER PROGRAM FOR DETERMINING THE ELASTIC-PLASTIC DEFORMATION AND CREEP STRAINS IN CYLINDRICAL RODS, TUBES AND VESSELS
Richard L. Puthoff Washington Jan. 1969 49 p refs
(NASA-TM-X-1723) Avail: CFSTI CSCL 20K

A generalized plane-strain elastic-plastic analysis and a creep analysis of a long hollow (or solid) cylinder are presented. These analyses use the method of successive approximations for solution. The equations are converted into finite difference formulation and programmed on an IBM 7094 Mod 2 digital computer. The cylinder is subjected to thermal gradients and pressure loads. The resulting stresses and strains calculated are printed as the output. A sample problem is included, along with program operation instructions and listings. Examples of components for which the analysis can be used are reactor pressure shells, fuel elements, and heat-exchanger tubes with symmetrical temperature gradients and constant pressure loads.
Author

N69-16126 Illinois Univ., Urbana.
METHOD OF ORTHOGONAL POLYNOMIALS IN PLANE THEORY OF ELASTICITY
Darlush Shadman (Ph.D. Thesis) 1967 81 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-8219

A new approach is proposed to solve the two dimensional problems of the theory of elasticity. This approach differs from the complex variable method of Kolosoff–Muskhelishvili in that it does not require the construction of a mapping function. Instead it relies on the construction of orthonormal bases for the Hilbert spaces associated with the given simply or multiply-connected regions. The results obtained in every case are shown to coincide exactly with those of the complex variable method. Specific examples are also given to illustrate the application of the method of orthogonal polynomials to various simply or multiply-connected domains.
Dissert. Abstr.

N69-16127 Illinois Univ., Urbana.
DISPERSION OF FLEXURAL WAVES IN CIRCULAR, BI-MATERIAL CYLINDERS
Robert Carl Reuter, Jr. (Ph.D. Thesis) 1967 51 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-8204

The frequency equation for flexural waves traveling in an infinitely long, bi-material, circular cylinder is obtained, using an extension of the Pochhammer–Chree theory for homogeneous rods. Several lowest branches of the frequency equation are presented and discussed for various ratios of the constituent cylinder radii. Experimental data is furnished and the range of applicability and accuracy of the theory are discussed.
Dissert. Abstr.

N69-16128 Princeton Univ., N. J.
THE SHRINK FIT PROBLEM INCLUDING CONTACT SHEAR
Leslie Ray Hill (Ph.D. Thesis) 1967 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-8930

The mixed boundary value problem of an infinite, hollow, elastic, right-circular cylinder with radial displacement and contact shear prescribed over a finite band on the outside surface and traction free on the remaining surfaces is formulated in terms of a set of inhomogeneous dual integral equations. Solution is obtained by the series method. A three-dimensional stress-freezing photoelastic experiment is performed to find a realistic contact shear distribution. Using the experimentally obtained values of radial displacement and contact shear as boundary conditions, the resulting stress and displacement fields are compared with those of the similar mixed boundary value problem neglecting contact shear. In addition, the problem prescribing only a contact shear in the finite band is solved. The stress and displacement components for the experimental contact shear applied are compared with those for an arbitrarily selected contact shear distribution.
Dissert. Abstr.

N69-16129 Oklahoma State Univ., Stillwater.
BUCKLING OF MULTILAYER PLATES BY FINITE ELEMENTS
Harry Richard Lundgren (Ph.D. Thesis) 1967 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-8447

A procedure was developed whereby the critical buckling stresses can be determined for multilayer sandwich plates with various boundary conditions. Individual layers are considered to be homogeneous and isotropic although the application of the method for orthotropic layers is indicated. There is no restriction to the number of layers and each layer may have different elastic properties and thickness. The basis of the development is the method of finite elements. An iterative procedure based upon the magnification factor is used to arrive at the critical stress. Constraints may be placed upon any of the generalized coordinates thereby making it possible to apply many combinations of boundary conditions. A set of simultaneous linear algebraic equations results and is solved to obtain the critical stresses. The number of equations is equal to the number of degrees of freedom.
Dissert. Abstr.

N69-16132 Illinois Univ., Urbana.
A LARGE DEFLECTION ANALYSIS METHOD FOR TRANSVERSELY LOADED ELASTIC-PERFECTLY PLASTIC CIRCULAR PLATES
James Gregory Crose (Ph.D. Thesis) 1967 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-8045

A technique is presented for the analysis of thin sandwich plates wherein the usual assumptions of small deflections and linearized material behavior are relaxed. The ultimate load carrying capacity of thin elastic-perfectly plastic plates has been shown to be considerably higher than indicated by the traditional limit analysis. This is because the ultimate load is only fully developed through large deflections of the plate. When lateral deflections reach a value greater than one-half the thickness of the plate, membrane forces assist in carrying the load and this effect becomes more important as the deflections increase. For simplicity of analysis, a circular plate is idealized to be of sandwich construction consisting of top and bottom sheets in plane stress and an infinitely rigid shear core which has no resistance to flexural or extensional forces. The von Mises yield criterion determines the beginning of plastic flow which is characterized by the Prandtl–Reuss flow rule in rate form.
Dissert. Abstr.

N69-16156*# Michigan Univ., Ann Arbor.
SENSITIVITY OF THE CREEP-RUPTURE PROPERTIES OF NICKEL-BASE SUPERALLOY SHEET TO SHARP EDGE-NOTCHES IN THE TEMPERATURE RANGE OF 1000°F–1400°F
David J. Wilson, James W. Freeman, and Paul D. Goodell
Washington NASA Jan. 1969 45 p refs
(Grant NsG-124)
(NASA-CR-1263) Avail: CFSTI CSLC 20K

Investigations to evaluate the severe time-dependent, edge-notch sensitivity known to occur in thin sheet nickel-base superalloys exposed under stress at 1000° and 1200°F are presented. Studies over a wide range of heat-treated conditions, has served to define the scope of this problem in 0.026-inch thick sheet. In addition, exploratory data have been obtained on the influence of notch acuity and sheet thickness on the notch sensitivity. Both smooth and edge-notched specimens fractured by the initiation and growth of intergranular cracks, followed by abrupt transgranular fracture due to the increase in stress caused by creep cracking. Analysis of these processes showed that the degree of notch sensitivity was strongly dependent upon the effect of the notches on the time required for the initiation of the creep crack and the early stages of its growth. There were some differences among alloys and within an alloy with heat treatment and test temperature.
Author

N69-16178# Aeronautical Research Labs., Melbourne (Australia).
FATIGUE TEST OF A WINJEEL WING JOINT TEST SPECIMEN Interim Report
P. J. Foden and R. Rowan Jul. 1968 21 p refs
(ARL/SM-328) Avail: CFSTI

In order to estimate the life of the center-section to outer wing joint of the Winjeel aircraft (Station 58), a specimen which

represents the most highly stressed region of the joint was fatigue tested under a program loading. To date, the safe life of the specimen which was demonstrated is 3,600 hours. At this life the 5/16" U.N.F. bolts in the joint are critical. No cracks were detected in any of the light alloy components. Author

N69-16183 Oklahoma State Univ., Stillwater.
FINITE, INELASTIC DEFORMATIONS OF CLAMPED RECTANGULAR MEMBRANES SUBJECTED TO IMPULSIVE LOADINGS
Charles Lindbergh (Ph.D. Thesis) 1967 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-8446

A practical method for analytically describing the finite deformation responses of clamped rectangular membranes to impulsive loadings is developed. The loading is assumed to be delivered in the form of either initial velocities or transient pressures. The transient pressures and the motion of the membrane are considered to be uncoupled. The governing differential equations of motion are formed through a consideration of dynamic equilibrium and converted through the use of the kinematic relations to yield a displacement formulation. Established numerical methods of structural dynamics are used in solving for the orthogonal displacement fields. A limited parametric investigation is included. Dissert. Abstr.

N69-16192 Wisconsin Univ., Madison.
VIBRATIONS OF ELASTIC AND VISCOELASTIC TIMOSHENKO BEAMS
Cheh-Chang Huang (Ph.D. Thesis) 1967 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-1088

Some basic analysis of free and forced vibrations of the viscoelastic Timoshenko beams and some further investigations of the elastic Timoshenko beams were made. In the analyses of the vibrations of viscoelastic Timoshenko beams, the correspondence principle for the elastic and viscoelastic constants has been used in the differential equations of motion or solutions. External dampings may be included in the analyses. Free and forced vibration problems were studied: to find the attenuation factor and the frequency of the damped free vibration, and to find the response in deflection, bending slope, bending moment and shear for the forced vibrations. In both cases, computer programs have been devised and numerical calculations have been made for illustrative examples. In the investigation of elastic Timoshenko beams, solutions of forced vibrations in closed and series forms were compared. Differential equations were derived and free vibration has been studied for beams carrying a system of heavy bodies and mounted on a system of spring supports. Dissert. Abstr.

N69-16203# California Univ., San Diego. Dept. of the Aerospace and Mechanical Engineering Sciences.
STRESS WAVE GENERATION IN A TEMPERATURE-DEPENDENT ABSORBING SOLID BY IMPULSIVE ELECTROMAGNETIC RADIATION
G. A. Hegemier and F. Tzung Jun. 1968 33 p refs
(Grant AF-AFOSR-1226-67)
(AD-678631; AFOSR-68-1618; TR-12) Avail: CFSTI CSCL 20/11

An elastic, partially transparent solid, occupying the half space $x > 0$, is subjected to uniform impulsive electromagnetic radiation at the surface $x = 0$. The deposition of radiant energy over a finite absorption depth gives rise to a distributed heat source within the solid (thermal shock) which, in turn, dilatates the medium and generates a stress wave. In this paper the nature of the stress-wave build up in the absorption layer is studied for the case of a temperature-dependent solid, i.e., when material properties vary with temperature. The mathematical problem is one of wave propagation in a non-homogeneous medium. An approximate solution to the posed problem is developed which readily exhibits the influence of temperature. Error bounds are provided. The results are illustrated by a numerical example. Author (TAB)

N69-16211*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL STUDY OF DEFLECTED-ELEVATOR FLUTTER ENCOUNTERED ON A T-TAIL AIRPLANE
Maynard C. Sandford and Charles L. Ruhlin Washington Feb. 1969 23 p refs
(NASA-TN-D-5024) Avail: CFSTI CSCL 20K

An exploratory study of a horizontal tail flutter encountered on the T-tail of a large multijet cargo airplane was conducted in the transonic dynamics tunnel at Mach numbers up to 0.93. The airplane flutter, consisting primarily of a coupled elevator rotation and stabilizer torsion oscillation at about 24 cps, occurred at a Mach number near 0.8 at several altitudes and was initiated only when the elevators were deflected about 8° or greater. The wind tunnel study employed a 1/8.5 size flutter model which consisted of a geometrically, dynamically, and elastically scaled empennage and aft fuselage, and dynamically and elastically, but not geometrically, simulated wings, nacelles, and forward fuselage. The basic flutter phenomenon experienced on the airplane was reproduced by the model in the wind tunnel although the model predicted considerably higher flutter speeds than those of the airplane at Mach number 0.8. The model flutter speed boundary was nearly flat from a Mach number of 0.41 to 0.89 and rose sharply and curved inward tending to form a closed flutter region at the extreme Mach numbers. In order to initiate model flutter, an elevator deflection angle of 8° in the trailing-edge-down attitude was required, whereas on the airplane, flutter occurred for an elevator deflection of 8° in either an up or down direction. Author

N69-16231*# Utah Univ., Salt Lake City. College of Engineering.
PARAMAGNETIC RESONANCE EFFECT IN VISCOELASTIC MATERIALS Annual Progress Report, 1 Jan.–31 Dec. 1968
K. L. De Vries and M. L. Williams 1 Jan 1969 16 p refs
(Grant NGR-45-003-037)
(NASA-CR-99238; UTEC-DO-68-109) Avail: CFSTI CSCL 20K

An electron paramagnetic resonance (EPR) investigation of the fracture mechanisms in viscoelastic media is reported. This method is considered a type of absorption spectroscopy capable of detecting unpaired electrons, which result from scission of covalent bonds. Such bonds are found in polymer chains present in all plastics and many propellants. The unpaired electrons in polymers can be generated by chemical attack, irradiation or mechanical damage, and this type degradation can be detected by EPR. The goals were: (1) investigate the spectra and determine which bonds ruptured during fracture, (2) determine activation energy, (3) determine effects of stress, (4) investigate loading or deformation rate, (5) investigate kinetics of fatigue in polymers, and (6) investigate temperature shift factor. Results show that strong EPR signals are obtained during tensile fracture of a number of different highly drawn fibers, and during such mechanical degradation as grinding, machining and slicing in every polymer studied. A list of reports and publications is included. F.O.S.

N69-16236 Illinois Univ., Urbana.
TRANSVERSE VIBRATION OF A CLASS OF PLATES WITH CLAMPED, SIMPLY SUPPORTED OR FREE BOUNDARY
Benedict Ching-San Sun (Ph.D. Thesis) 1967 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-8239

The fundamental and higher modes of natural frequencies of the transverse vibration of a class of plates having clamped, free and simply supported boundary conditions are studied. The plate thickness is considered to be thin in comparison with other dimensions. The Rayleigh–Ritz method is used with vertical shear and rotatory inertia being assumed negligible. Polynomial in Cartesian coordinate are employed to define the mode shapes corresponding to the various frequencies. Numerical computations are presented only for clamped boundary conditions. Procedures for obtaining solutions with other boundary conditions are presented in detail. The calculated frequencies and nodal patterns for circular, square and rectangular shapes are in good agreement with existing data. Frequencies and nodal patterns for some typical shapes in this group including elliptical plates with clamped boundary conditions are also presented in this investigation. Dissert. Abstr.

N69-16241 Ohio State Univ., Columbus.
VIBRATIONS OF TUBES CONTAINING FLOWING FLUID
Robert Alfred Stein (Ph.D. Thesis) 1967 192 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-8885

This study considers a long, continuous tube which is completely filled with a flowing fluid. When the tube vibrates laterally, the fluid flow field is affected; conversely, the fluid interacts with the walls of the tube and alters the vibrational characteristics of the tube. In this work, the fluid is idealized to represent a uniformly distributed mass moving within the tube. The influence of the motion of the tube on the fluid is neglected. The equations of motion are developed using D'Alembert's Principle and, in addition, are derived utilizing Hamilton's Principle as applied to a nonconservative system. The equations of motion are solved by employing Laplace and Fourier transforms. An analytical solution is developed to describe the transverse vibrations of an infinitely long tube. The influence of external damping, as well as the effect of a linearly elastic foundation, has been incorporated into the analysis. Dissert. Abstr.

N69-16245# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF EXPERIMENTAL DETERMINATION OF INTERNAL FRICTION IN SOLID MATERIALS
Ye. S. Sorokin 12 Jan. 1968 39 p refs Transl. into ENGLISH from Tr. Mosk. Inst. Inzh. Zheleznodorozhnogo Transp. (Moscow), no. 193, 1964 p 5-41
(AD-679383; FTD-MT-24-219-67) Avail: CFSTI CSCL 20/11

A critical review of fifteen experimental methods which are used in studying internal friction in solids are divided into nine groups of basically different techniques in order to facilitate the use of these methods and to discuss erroneous interpretations of some of them. Author (TAB)

N69-16253# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
ON A PROBLEM OF THERMO-VISCOELASTICITY
P. A. Pucik and W. G. Knauss Dec. 1968 9 p refs
(NGL-05-002-005)
(NASA-CR-99219; CALCIT-SM-68-17) Avail: CFSTI CSCL 20K

The problem considered is that of a hollow or solid circular cylinder of thermorheologically simple material, infinite in extent in the axial direction, with a temperature distribution which may be any prescribed function of radius and time. Normal stresses which are prescribed functions of time only, $\sigma_r(t)$ and $\sigma_\theta(t)$, act on the lateral surfaces and a uniform axial strain $\epsilon_z(t)$ are prescribed as any arbitrary function of time. It is also assumed that ν_{rel} = const. $\leq \nu_e = 1/2$. A complete and closed form analytic solution for the stresses and displacements appears to be very difficult. However, a relatively simple expression is found for the total axial force $F_z(t)$. Although the force $F_z(t)$ is an integral of the stress distribution, it is exact and may therefore provide a useful check for numerical calculations. Author

N69-16270 Virginia Univ., Charlottesville.
AN ANALYTIC INVESTIGATION OF A FLOATING SPHERICAL SHELL WITH A LARGE CIRCULAR OPENING
David Cheng-tung Chang (Ph.D. Thesis) 1967 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 67-17654

The dissertation is concerned with the analytic investigation of a floating thin spherical shell with a large circular opening constrained by a stiffening device. The structure is proposed to be used as a support system for a large steerable antenna up to 750' in diameter for radio astronomy applications. Based on Love's first approximation the general governing differential equation for the shell under arbitrary loading conditions is first derived in the simple form of one fourth order partial differential equation for one unknown complex function. The stiffening device is represented by an equivalent system of linear springs uniformly distributed around the opening. Two kinds of support conditions, hydrostatic support and air pressurized support, are studied. Closed form solutions which satisfy both the simplified shell equation and the prescribed boundary conditions of the problem are obtained with an accuracy consistent with the basic assumptions used in the analysis. Dissert. Abstr.

N69-16272 Illinois Univ., Urbana.
BUCKLING OF PLATES SUBJECTED TO NONUNIFORM HEATING
Bruce Robert Dewey (Ph.D. Thesis) 1967 62 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-8050

The critical temperature conditions for the elastic stability of nonuniformly heated, simply supported rectangular plates are predicted by a method utilizing the second variation of the potential energy. Nonhomogeneity of the material due to the variation of the modulus of elasticity with temperature leads to an eigenvalue problem which is solved iteratively. Numerical results from the theory agree favorably with published data for homogeneous plates having sinusoidal temperature distributions. The importance of considering nonhomogeneity is discussed through the use of a numerical example. Experimental verification of the theory is achieved with epoxy plates having a skewed, bell-shaped temperature distribution. This research has possible application to nuclear reactor fuel plates where nonhomogeneous material and nonuniform heating are important factors. Dissert. Abstr.

N69-16311 Clemson Coll., S. C.
THERMAL AND MECHANICAL STRESSES IN THIN CIRCULAR SANDWICH SHELLS
Robert Ned Brannock (Ph.D. Thesis) 1967 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-9019

A general theory for bending and stretching of thin sandwich shells is developed. The shell may be of open or closed profile; loads may be surface temperatures, axial thrusts, and distributed tractions; face-sheets may be of unequal thicknesses; and the core material may possess orthotropic properties. Transverse normal deformations are allowed to occur in the core material, and the core material is assumed to be attached at the common surfaces of the core and face-sheets. Components of displacements of the points on the middle surfaces of the face-sheets serve as dependent variables. The principle of the minimum potential energy serves as the

basis of the derivation of the differential equations of equilibrium and boundary conditions in terms of the dependent variables and their derivatives. Two assumptions, one involving an approximation of the kinematic relations for core material shearing strains, and the other, assuming a linear temperature distribution through the core material thickness, are justified. Dissert. Abstr.

N69-16313 Illinois Univ., Urbana.
ANALYSIS OF ELASTO-PLASTIC SHELL STRUCTURES
Nabil Abdalla Shoeb (Ph.D. Thesis) 1967 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-8221

The behavior was studied of a cylindrical shell roof under a progressively increasing load. For this purpose a mathematical model is used to replace the continuum. It consists of rigid bars joined together by deformable nodes. The nodes bear the material properties of the shell. The nodes are composed of two deformable elements at the extreme fibers enclosing a rigid core. Though this model is adaptable for any kind of shallow shell rectangular in plan form it is used here only for cylindrical shells as an example to demonstrate the application of the method. Different boundary conditions are formulated for the model. The material is assumed elastic perfectly plastic. In the elastic range the material is assumed to obey Hooke's law. For the determination of the initiation of the plastic flow the Mises–Henckey yield criterion is used. In the plastic range an incremental form of the Prandtle–Reuss relations modified for the state of plane stress is used. Dissert. Abstr.

N69-16314 California Univ., Berkeley.
LINEAR PLATE THEORY WITH SIMPLE FORCE DIPOLES
Edmond Lee Kyser (Ph.D. Thesis) 1967 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-10358

The purpose is to discuss and apply the linear theory of an initially flat deformable elastic surface with simple force dipoles. The development includes thermodynamical effects and all first order strain gradients, and is exact within the context of a linear theory of a deformable surface with simple force dipoles. The basic equations are obtained as a special case of an existing multipolar surface theory. In the case of a flat plate, the relation between this theory and an existing linearized three-dimensional dipolar theory is indicated through the use of asymptotic methods. For an isotropic material, the basic equations separate into two groups, one for extensional deformation and one for bending. With reference to the extensional theory a representation of the general solution is obtained in terms of four displacement potentials. For the static case with no body forces, the displacement potentials are obtained by solving two Helmholtz equations and two Laplace equations. Dissert. Abstr.

N69-16316# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
A STUDY OF ADHESIVE JOINT FAILURES BY EVAPORATIVE RATE ANALYSIS
Raymond F. Wegman Oct. 1968 24 p refs
(AD-678544; PA-TR-3746) Avail: CFSTI CSCL 20/11

Evaporative rate analyses using Carbon-14-tagged radioactive chemicals are used to identify the location of fracture in ruptured adhesive-bonded joints. Evidence is shown for both adhesive failure and adherend failure (surface layer failure). Author (TAB)

N69-16373# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
ON THE NUMERICAL DETERMINATION OF SHRINKAGE STRESSES
Frances Bauer and Edward Reiss Sep. 1968 25 p refs
(Contracts Nonr-285(42); AT(30-1)-1480)
(AD-678588; IMM-371; NYO-1480-109) Avail: CFSTI CSCL 20/11

An iterative method is employed to obtain numerical solutions of a two dimensional mixed boundary value problem for rectangular elastic plates. The theory of plane stress is used. This problem is encountered when the edge of a uniformly heated plate is bonded to a rigid body and then allowed to cool. The numerical results are compared with two formal asymptotic expansions of the solution. They correspond to the limiting cases of a thin strip and a long strip. The development of boundary layers near the edges of the plate is observed. The numerically determined stresses achieve their largest values at the corner of the bonded edge. Author (TAB)

N69-16398 Illinois Univ., Urbana.
THE FOURIER TRANSFORM USED AS A NUMERICAL TECHNIQUE FOR THE SOLUTION OF TRANSIENT VIBRATION PROBLEMS
Clark Reid Barker (Ph.D. Thesis) 1967 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-8023

The use of the Fourier transform as a numerical technique to solve transient vibration problems is investigated. Fourier transform is used to eliminate the independent variable time from the description of a transient vibration problem. Due to the complexity of the necessary mathematical integrations, all integrations are performed numerically. Three steps to apply the method are defined and discussed: (1) obtain the system transfer function; (2) obtain the excitation transform; and (3) form the response transform and perform the inversion integration. The system transfer function for both lumped parameter and continuous systems is examined. Six methods of computing the excitation transform are discussed for excitation forms known either in analytical or tabular form. Two methods are studied to perform the final inversion integration. The technique is applied to two sample problems and the accuracy of the solution is obtained. Dissert. Abstr.

N69-16408 Oklahoma State Univ., Stillwater.
STRESS AND DISPLACEMENT ANALYSIS OF PLANAR STIFFENED SHELL STRUCTURES
Gordon Campbell Stone (Ph.D. Thesis) 1967 196 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-8506

The matrix force and direct stiffness methods of structural analysis are used to predict the stress and deflection behavior of a planar, tapered stiffened shell skin panel. A corresponding experimental investigation is conducted to provide a basis for the evaluation of the analytical results. The skin panel used in the experimental phase of the investigation is designed to simulate the idealizations commonly used in aerospace structural analysis. Refinements in the analysis capability are based on the matrix force method. Matrix algebra digital computer programs are developed and presented which provide a capability for easily implementing the extended matrix force method. An analysis of the test structure by the direct stiffness method is presented, the results of which serve as a theoretical check and comparison of those from the extended matrix force method of analysis. Dissert. Abstr.

N69-16410 Princeton Univ., N. J.
DYNAMIC RESPONSE OF A SEMI-INFINITE SOLID PRODUCED BY SURFACE LOADS
Boris Simpser-Dubovoy (Ph.D. Thesis) 1967 407 p
Avail: Univ. Microfilms: HC $18.45/Microfilm $5.20 Order No. 68-8962

A physically consistent mathematical model for the study of elastic solids is proposed. Based on this model the equations of motion for a point in the solid are derived, and their validity is proved by transforming them to well-known Navier's equation by means of an inverse finite difference operator. The physical consistency of the model permits the derivation of the equations of motion, gives the physical interpretation of each step in the mathematical derivation and permits the construction of a physical representation of this model to perform experimental studies. A family of four general methods of solution is proposed for the equations of motion. Essentially, these are methods of integration for partial differential equations with three dependent and four independent variables. Dissert. Abstr.

N69-16419# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RECENT ACTIVITIES IN PHOTOELASTICITY AND PHOTOPLASTICITY

Yu-ch'uan Chia 1 Dec. 1967 43 p refs Transl. into ENGLISH from Li Hsueh Hsueh Pao (Communist China), v. 8, no. 2, 1965p 77–100

(AD-678764; FTD-HT-23-732-67) Avail: CFSTI CSCL 11/7

The report reviews current developments and research in photoplasticity techniques related to the solution of stress problems. Equipment used, model materials, coating methods, and solutions of plane, three-dimensional, and dynamic stress problems are described. Author (TAB)

N69-16425# California Univ., San Diego. Dept. of the Aerospace and Mechanical Engineering Sciences.

THERMAL BUCKLING OF SHALLOW BIMETALLIC TWO-HINGED ARCHES

B. Vahidi and N. C. Huang Aug. 1968 36 p refs

(Grant AF-AFOSR-1226-67)

(AD-678532; AFOSR-68-1959; TR-13) Avail: CFSTI CSCL 13/13

The snap-through phenomenon of shallow bimetallic two-hinged arches due to temperature rise is analyzed. Two types of arch geometry are included. The effect of the position of supporting hinges on the critical temperature rise for snap-through is discussed. Comparisons are made between the present more accurate solution of the critical temperature rise and the approximate solution obtained by Timoshenko. Striking discrepancies are found between these two solutions. Author (TAB)

N69-16469*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A METHOD FOR COMPUTATION OF VIBRATION MODES AND FREQUENCIES OF ORTHOTROPIC THIN SHELLS OF REVOLUTION HAVING GENERAL MERIDIONAL CURVATURE

Howard M. Adelman, Donnell S. Cathernes, and William C. Walton, Jr. Washington Jan. 1969 88 p refs

(NASA-TN-D-4972) Avail: CFSTI CSCL 20K

A procedure is described for computing the vibration modes and frequencies of thin shells of revolution having general meridional curvature and orthotropic elastic properties. The procedure is based on the finite element method in which the direct stiffness approach is used. A geometrically exact finite element is employed. A computer program based on this procedure has been written and details of the program are described. The geometric characteristics of the shell are used as inputs to the program in the form of functions of the meridional coordinate. The stiffness and mass matrices are computed by numerical integration by use of the trapezoidal rule. The computer program is applied to several shell configurations including two cylinders, two conical frustums, shells of both positive and negative Gaussian curvature, and an annular plate. Frequencies are correlated with frequencies from previous investigations for these shells. The agreement between results of the present analysis and results from the previous investigations is generally excellent. Author

N69-16514# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

VIBRATION AND STRENGTH UNDER ALTERNATING STRESSES (SELECTED ARTICLES)

17 Jan. 1968 40 p refs Transl. into ENGLISH from the book "Kolebaniya i Prochnost' pri Peremennykh Napryazheniyakh" Moscow, Nauka, 1965 p 149–158; 170–183

(AD-678687; FTD-HT-23-1452-67) Avail: CFSTI CSCL 11/4

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2. EFFECTIVENESS OF STRESS CONCENTRATION AND THE SCALE EFFECT IN TWO STAGES OF CYCLIC LOADING R. D. Vagapov p 14–30 refs (See N69-16516 06-32)

N69-16515# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PECULIARITIES OF TRANSVERSE BENDING OF SANDWICH BEAMS WHOSE PANELS ARE BONDED WITH DEFORMABLE ADHESIVE

R. D. Vagapov et al *In its* Vibration and Strength under Alternating Stresses (Selected Articles) 17 Jan. 1968 p 1–13 refs (See N69-16514 06-32)

Avail: CFSTI

A study is made of certain features of the transverse shear of composite beams. It is hypothesized that, up to a particular value of tangential stresses τ_0 in the plane of adhesion, the glue rigidly bonds the layers. From the moment that the stress τ_0 is reached, plastic flow of the adhesive and slip between layers 1 and 2 commence. This statement of the problem presupposes that the glue corresponds to a model of a stiff plastic body and the thickness of the adhesive is small in comparison with the thickness of the bonded layer and thus can be ignored. Basic equations of shear of an infinitely wide two-layered plate are presented. Two sets of related functions are stated: the first gives expressions for stresses and displacements arising from elastic deformations of the body; the other accounts for plate distortion as a solid body. Several conditions of stress and deformation are developed in demonstration of the system solution. A description of an experimental method is given, and plots of longitudinal deformations of composite beams are shown. Author

N69-16516# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECTIVENESS OF STRESS CONCENTRATION AND THE SCALE EFFECT IN TWO STAGES OF CYCLIC LOADING

R. D. Vagapov *In its* Vibration and Strength under Alternating Stresses (Selected Articles) 17 Jan. 1968 p 14–30 refs (See N69-16514 06-32)

Avail: CFSTI

The roles of stress concentrations and the size of a specimen in its fatigue resistance are studied. Tests were conducted on Armco steel specimens some of which were smooth and others of which were notched. Various stress paths were studied with the ratios of principal and secondary stresses to the fatigue limit as

experimental parameters. Curves are shown for varying specimen configurations and the number of loading cycles. In additional test measurements note is made of the stages of specimen failure, and the appearance of cracks and ultimate specimen fracture. A discussion of probabilistic and regression methods is given and related to the fatigue limit and number of load cycles. The size effect was measured in extensive tests on steel 45 with the use of a wide variety of specimen sizes and configurations. An NU testing machine was used. Significant differences were noted in the fatigue behavior of notched versus smooth specimens. Author

N69-16519 Oklahoma State Univ., Stillwater.
NONLINEAR ANALYSIS OF RECTANGULAR PLANE FRAMES BY MATRIX POLYGON
Philip Norcross Eldred (Ph.D. Thesis) 1967 66 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-8397

The purpose is to develop a method for the nonlinear analysis of rectangular plane frames. The nonlinear effects which are considered include the formation of plastic hinges, reduced plastic moment values, changes in frame geometry, nonlinear moment-curvature relationship and bowing of members. The nonlinear effects are included as corrections to an elastic flexibility analysis based on the string-polygon method. The joint moments and sidesway deflection are determined by an iteration procedure. A method is presented for the analysis of inelastic beam-columns subjected to end moments. Plastic hinges are accounted for by means of the augmented flexibility matrix. Dissert. Abstr.

N69-16525# Forsvarets Forskningsanstalt, Stockholm (Sweden).
TIME-INDEPENDENT ELASTIC-PLASTIC THEORY WITH UNIAXIAL STRESS CONDITIONS [TIDSOBEROENDE ELASTISK-PLASTISK TEORI VID ENAXLIGT TOEJNING STAND]
C. A. Skloff Sep. 1967 30 p refs In SWEDISH
(FOA-2-C-2186-44) Avail: CFSTI

The time-independent elastic-plastic theory as used for plane shock wave propagation in static and dynamic structures or materials was verified by experimental observations. It was noticed that at high rates of wave propagation, such as occur in shock waves, many materials show some form of rate effects. This indicates that the time-independent theory fails to give correct results in all details. The method should therefore only be used for simple calculations of the generalized wave propagation. K.W.

N69-16598# Forsvarets Forskningsanstalt, Stockholm (Sweden).
LITERATURE STUDY ON METAL DEFORMATION AND STRENGTH PROPERTIES, ESPECIALLY UNDER HIGH LOADING RATES [LITTERATURSTUDIE OEVER METALLERS DEFORMATIONS- OCH HALLFASTHETS-EGENSKAPER, SPECIELLT VID HOEGA BELASTNINGSHASTIGHETER]
C. A. Askloef, A. Nylander, and A. Persson Sep. 1967 95 p refs In SWEDISH
(FOA-2-A-2497-44) Avail: CFSTI

Information from recent literature on strength and deformation characteristics of metals has been selected for discussion in this paper. Covered are single and multiple dislocations, deformations leading to fracture, single-crystal and polycrystal materials, elasticity, viscoelasticity, plasticity, crack initiation, and fracture. A trend in the reviewed information is noticed which indicates that the macroscopic and microscopic understanding of these metal properties is satisfactory for low and moderate rates of deformation, but knowledge is very limited when the rates of deformation are high ($> \text{circa } 10^3\ s^{-1}$). K.W.

N69-16650 Illinois Univ., Urbana.
FATIGUE BEHAVIOR OF WELDED THIN WEB GIRDERS AS INFLUENCED BY WEB DISTORTION AND BOUNDARY RIGIDITY
David William Goodpasture (Ph.D. Thesis) 1967 218 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-8089

Ten thin web girders were fabricated and tested in fatigue and statically in order to determine the influence of initial web distortion on the fatigue behavior of thin web girders and to determine the distribution of stresses along the panel boundaries. Four girders with and six without longitudinal stiffeners were tested in order to determine the influence of longitudinal stiffeners on fatigue behavior. Parameters considered were flange rigidity, transverse stiffener rigidity, type of loading, and initial lateral web deflections. Fatigue tests were performed on all ten girders. Upon completion of the fatigue tests, the girders were instrumented with electrical wire resistance strain gages and strain measurements were made during static tests to failure of the girder test section. The results obtained from these tests were analyzed and compared with the results obtained from nineteen similar tests performed in a previous investigation. Dissert. Abstr.

N69-16700 Arizona Univ., Tucson.
CONCRETE FAILURE THEORY, MECHANISM, AND CONCEPT
Himan Aldridge Gillespie (Ph.D. Thesis) 1968 271 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 68-8305

The primary objective of this dissertation is to present a comprehensive accumulation of data in a manner which can more clearly define the fracture process and fracture mechanism of concrete. While strength theories describe alternate conditions for failure itself, fracture theories attempt to construct reasons for the beginning of failure and under what conditions fracture will progress. Fracture mechanics is then a knowledge of the influence of stressing conditions on the fracture behavior of a material. The approach used in this study of the basic concrete fracture parameters includes tests and observations at the phenomenological and the structural levels, i.e., in the macromicroscopic range, with other references drawn upon for data at the molecular-atomic level. Dissert. Abstr.

N69-16769 Oklahoma Univ., Norman.
FRAME ANALYSIS OF THIN SHELLS
Ronald Anthony Apanian (Ph.D. Thesis) 1967 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-8358

The purpose of this research is to develop a method for determining the deformations in a thin shell of double curvature whereby the stiffening contribution of the ribs and edge beams is incorporated directly in the solution. The analysis includes membrane and bending effects. The material of the shell is considered to be homogeneous and isotropic. The structure is idealized as consisting of a number of plane triangular elements connected together at their node points. The elastic characteristics of the element are expressed in terms of an assumed general stress distribution within each element. Upon application of the principle of minimum complementary energy, the specific stress expressions are determined and employed to formulate the element stiffness. The elemental stiffnesses are then combined to define the total stiffness of the structure. The method is restricted to smoothly curved thin shells. Dissert. Abstr.

N69-16817# Ohio State Univ., Research Foundation, Columbus.
STRESS AND DEFLECTION ANALYSIS OF FIBROUS COMPOSITE MATERIALS UNDER EXTERNAL LOAD: FURTHER STUDIES
A. W. Leissa, W. E. Clausen, and G. K. Agrawal. Wright-Patterson AFB, Ohio AF Mater. Lab. Jul. 1968 102 p refs
(Contract AF 33(615)-3298)
(AD-678574; AFML-TR-68-203) Avail: CFSTI CSCL 11/4

The report presents the fundamentals of applying the analytical method of point matching to the problem of fibers having transverse isotropy and transverse shear loading, and fiber arrays having irregular spacings. Irregular spacings are accommodated by a multiple-pole method of analysis, and the technique is formulated for a seven-fiber array. Considerable numerical results for overall composite elastic moduli and stress concentrations are given for fibers having circular, elliptical, square, and rhombic shape. A complete statement listing is given for the current, improved computer program in use. Author (TAB)

N69-16862# Frankford Arsenal, Philadelphia, Pa.
ON THE PROBABILITY OF DEFLECTION OF A RIGID SPHERE WHICH COLLIDES WITH A WOODLIKE STATIONARY CYLINDER
John K. Gohagan Sep. 1968 14 p
(AD-678586; FA-TN-1127) Avail: CFSTI CSCL 20/11

This paper is a simplified probabilistic treatment of the deflection of a rigid sphere on collision with a woodlike stationary cylinder. Author (TAB)

N69-16853# State Univ. of New York at Buffalo. Div. of Interdisciplinary Studies and Research.
STRESS, STRAIN AND VELOCITY FIELDS IN A SUDDENLY LOADED SEMI-INFINITE ROD OF MATERIAL DESCRIBED BY NONLINEAR VISCOELASTIC MODELS
Francis A. Cozzarelli and Richard P. Shaw Aug. 1968 89 p refs
(Contract Nonr-4449(00))
(AD-678650; Rept-29) Avail: CFSTI CSCL 20/11

A description of nonlinear one dimensional viscoelastic material behavior is given in terms of models which incorporate a combination of strain hardening and age hardening techniques for generalizing creep laws to viscoelastic constitutive equations. After some discussion of the behavior of these models under various loadings, the problem of wave propagation down a suddenly loaded semi-infinite rod of material described by one of these nonlinear constitutive equations is solved by numerical integration along the characteristics of the problem. A linear instantaneous elastic response is assumed in all cases. Author (TAB)

N69-16872*# Texas A&M Univ., College Station. Space Technology Div.
NONLINEAR ANALYSIS OF SHELLS OF REVOLUTION
Annual Report
James A. Stricklin 25 Jan. 1969 6 p refs
(Grant NGL-44-001-044)
(NASA-CR-73650; Rept-69-53) Avail: CFSTI CSCL 20K

Accomplishments during the last year are cited. These include a nonlinear stability analysis of the Apollo aft heat shield and a stress analysis of the Subsystems Test Bed. Author

N69-16880# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
A NEW FINITE ELEMENT MODEL FOR SOLID CONTINUA
Interim Report
Pin Tong Jul. 1968 31 p refs
(Contract F44620-67-C-0019)
(AD-678600; ASRL-TR-144-2; AFOSR-TR-68-1860) Avail: CFSTI CSCL 20/11

The proposed finite element model is based on separate assumptions of interior and interelement displacements and on the assumed boundary tractions of each individual element. The associated variational functional for this model is presented. This method has the same merits of the assumed stress method in that a compatibility displacement function at the interelement boundary can be easily constructed. In the plate bending problems, the matrix to be inverted to obtain the element stiffness matrix by the present method is, in general, of smaller order than that of the assumed stress method when the same order of approximation is used in both methods. Author (TAB)

N69-16895 National Lending Library for Science and Technology, Boston Spa (England).
STRESSES IN A HOLLOW THICK-WALLED CYLINDER CAUSED BY UNEQUAL TEMPERATURES AT THE CIRCUMFERENCE
D. P. Elizarov, S. Yasin, and L. A. Fedorovich 20 Sep. 1968 8 p ref Transl. into ENGLISH from Energetika (Kharkov), v. 10, no. 12, Dec. 1967 p 80-84
(NLL-CE-Trans-4861-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.

In order to verify an approximate solution to the stress problem obtained by S. Ya. Yarema on the basis of shell theory, an experiment was conducted using a cylindrical steel tube, 273 by 36 mm and 1600 mm long. The tube was set up vertically on a special stand and provided with thermal insulation. Eight electric heaters were installed inside the tube at equal distances around the circumference, each heating the tube over a 45° arc. Variation in the load or disconnection of some of the heaters created the required temperature field about the circumference. Two types of measurement were performed: the temperature on the external surface of the tube was determined, and the stresses at four points on the circumference were obtained. The results verify the use of Yarema's method for an approximate calculation of the axial stresses in thick walled tubes. Apart from axial stresses, however, considerable tangential stresses occur in thick walled tube lines which are not considered in the theory of shells. It was also found that the magnitude and character of the stress distribution depend on the shape of the temperature curve. A.C.R.

N69-16901# Stanford Univ., Calif. Dept. of Applied Mechanics.
NONLINEAR VISCOELASTIC STRESS ANALYSIS WITH SMALL DILATATIONAL CHANGES
Edward C. Ting Sep. 1968 90 p refs
(Contract Nonr-225(69))
(AD-679070; REPT-14; TR-189) Avail: CFSTI CSCL 20/11

A derivation is given of the nonlinear stress constitutive equation for viscoelastic materials with small dilatational changes. This particular derivation results in a form for the constitutive equations which is suitable for application in solving boundary value problems. The resulting equations are applied to obtain the quasi-static solution for a pressurized viscoelastic hollow cylinder bonded to an elastic casing. The inner boundary of the cylinder is assumed to be ablating and hence time-dependent. The problem is solved for linear and nonlinear, both incompressible and compressible, materials. For linear problems, both analytical and numerical solutions are obtained. For nonlinear problems, numerical solutions are evaluated by using finite difference techniques and assuming particular forms of kernel functions in the constitutive equation. The linear and nonlinear results are compared. The effects due to the material nonlinearity and compressibility are discussed. Author (TAB)

N69-16935*# Stanford Univ., Calif. Aeronautics and Astronautics Dept.
THEORETICAL CONSIDERATIONS OF SOME NONLINEAR ASPECTS OF HYPERSONIC PANEL FLUTTER Annual Report, 1 Sep. 1966–31 Aug. 1967
S. C. McIntosh 31 Aug. 1967 39 p refs
(Grant NGR-05-020-102)
(NASA-CR-73882; AR-2) Avail: CFSTI CSCL 20K

This research program investigates in a systematic manner the effects on panel response and stability of nonlinear (nonviscous) aerodynamic loading at hypersonic Mach numbers. It is of particular interest to determine whether or not nonlinear aerodynamic effects will provide a theoretical explanation for experimentally observed nonlinear behavior. The equations of motion for a panel (plate-column) on hinged supports, with both aerodynamic and panel geometric nonlinearities, are derived and discussed in detail. Representative solutions for various cases are then presented, including an unanticipated diversion into the problem of interpreting results from zero system damping. Additional sections deal briefly with the work performed on a clamped panel and on methods of analysis, and a final section discusses topics of research to be considered during the next year. Author

N69-16973*# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
CYLINDRICAL AND SPHERICAL SHELLS WITH CRACKS
F. Erdogan and J. Kibler Oct. 1968 22 p refs
(Grant NGR-39-007-011)
(NASA-CR-73709) Avail: CFSTI CSCL 20K

The symmetric problem for the cylindrical and spherical shells containing a meridional crack is considered. The problem is solved for a uniform membrane load and a uniform bending moment applied to the surface of the crack. The extensional and bending components of the stress intensity factor ratio are obtained as functions of shell parameter and are tabulated. The results are also plotted in order to compare them with the existing asymptotic solutions. Author

N69-16983 Oklahoma State Univ., Stillwater.
THE EXISTENCE CRITERIA OF ONE-GENERAL CONSTRAINT MECHANISMS
Atmaram Harilal Soni (Ph.D. Thesis) 1967 236 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.05 Order No. 68-8501

The existence criteria of a six-link six-revolute mechanism was investigated to study one general constraint mechanisms. The method concentrates on examining the rank of a coefficient matrix [M] which is obtained by giving a differential displacement to the screw matrices describing the closure condition of a space mechanism. It is found that the rank of the coefficient matrix is directly related to the existence of the number of general constraints. When the rank of this coefficient matrix is six, the mechanism giving this matrix is free from any general constraints. When, however, the rank of the matrix is five, the mechanism satisfying this condition has one general constraint. The coefficient matrix [M] is composed of two sets of three equations. Each of these sets in turn describe the three principal axes of rotations and translations. The developed iterative method for arriving at the coefficient matrix [M] is also capable of giving the displacement analysis, finding the dead centers and limit positions of the mechanisms. Application of this method to the variational study provided the existence criteria of the six-link six-revolute mechanism. Dissert. Abstr.

N69-16987 National Lending Library for Science and Technology, Boston Spa (England).
ON THE CHANGES OF SOME PROPERTIES OF STEEL ALTERNATING STRESSES [UEBER DIE AENDERUNGEN EINIGER EIGENSCHAFTEN VON STAL BEI DAUERWECHSELBEANSPRUCHUNG]
Gunter Kirschling 12 Mar. 1968 14 p refs Transl. into ENGLISH from Materialpruefung (Duesseldorf), v. 9, no. 2, 1967 p 45–49 In ENGLISH and GERMAN
NLL-EE-Trans-1744-(377.45)) Avail: Natl. Lending Library, Boston Spa, Engl.

Using a bending/torsion fatigue machine, which neither keeps constant the torsional moment nor the torsional angle, torsional fatigue tests were carried out on specimens of unalloyed, normalized steels with varying carbon content. It is illustrated systematically that, above a dynamic elastic limit (1/2 to 2/3 of the fatigue limit), the torsional moment decreases initially with increasing number of cycles and rises after having reached a minimum. The damping capacity, given as hysteresis loss relative to the fictive elastic energy, increases initially with a growing number of cycles and decreases after having passed a maximum. A constant limit of damping was not observed. The findings with regard to the torsional fatigue tests were confirmed by the observation of analogous changes in deflection during rotating-bar fatigue tests. The plastic deformations resulting from changes of the torsional moment and the deflection could be established by an increasing hardness. From the results of the hardness measurements a fatigue strain-hardening hypothesis is derived and described. Author

N69-16999 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS INTO THE HYDROMECHANICAL STRESS CAUSED BY AN ATTACK BY DROPS [UNTERSUCHUNGEN ZUR HYDROMECHANISCHEN BEANSPRUCHUNG BEI TROPFENSCHLAG]
Friedrich Erdmann-Jesnitzer et al 18 Oct. 1968 57 p refs Transl. into ENGLISH from Arch. Eisenhuettenw. (Duesseldorf), v. 37, pt. 12, Dec. 1966 In ENGLISH and GERMAN
(NLL-EE-Trans-1808-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.

To determine the hydromechanical stress caused by the impact of water drops, tests were conducted on lead, copper, and iron samples. Comparisons are drawn between drop corrosion and cavitation; it was found that cavitation plays no decisive role in the drop impact action. Drop impact tests show three different types of material stress: (1) In the direct vicinity of the impact center, a uniform pressure extends briefly over a large area of the material surface. In soft materials, this creates a deformation trough; in harder materials, it leaves no visible trace. (2) At a certain distance from the impact center parallel to the line of the first contact between jet and test piece surface, two symmetrical zones occur in which an oscillating pressure force moves across the material surface. In soft materials, a wave-shaped surface deformation occurs; in hard materials, permanent breaks are produced after frequent repetitive impacts. (3) Due to irregularities in the fluid surface, high local pressure points are distributed over the entire impact surface. In the case of materials capable of plastic deformation, microscopically small local deformations in the form of craters occur. M.G.J.

N69-17030*# Stanford Univ., Calif. Dept. of Applied Mechanics.
A MIXED BOUNDARY VALUE PROBLEM IN VISCOELASTICITY WITH TIME-DEPENDENT BOUNDARY REGIONS
T. C. T. Ting Oct. 1968 18 p refs
(Contract Nonr-225(69))
(AD-679071; REPT-15; TR-191) Avail: CFSTI CSCL 20/11

A correspondence principle of linear viscoelasticity theory for mixed boundary value problems with time-dependent boundary regions was studied by Graham in which the associated elastic solutions are required to satisfy certain restricted conditions. In this

paper a generalized correspondence principle is given in which no restrictions are imposed on the associated elastic solutions. The results can be extended to thermo-rheologically simple viscoelastic media if the temperature field is either purely position-dependent or purely time-dependent. Author (TAB)

N69-17089 Volt Information Sciences, Inc., Washington, D. C.
ON THE DISINTEGRATING ACTION OF METEORITIC IMPACTS
K. P. Stanyukovich et al. Greenbelt Md. NASA 27 Jan. 1969 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (Moscow), v. 57, no. 2, 1947 p 129-132
(Contract NAS5-12487)
(NASA-CR-73713; ST-IM-LPES-10802) Avail: CFSTI CSCL 03C

This is a brief review of the early days, concerning the action upon planets and asteroids of crater-forming meteorites. The calculations performed of critical velocities and quantity of matter lost at impact are all based upon the shock wave theory, and use is made of gas dynamics equations. These results apply to the Earth, Mars, Moon and asteroids. Author

N69-17131 Boeing Co., Seattle, Wash.
THE EFFECT OF DRAG UPON THE FLUTTER CRITICAL SPEED
Augustin L. Petre Sep. 1968 19 p refs Transl. into ENGLISH from a Rumanian Report Presented at ICAS Meeting
(F-231) Avail: Issuing Activity

Differential equations are established for small oscillations in flexure and torsion for elastic lift surfaces in the pressure of a complete system of aerodynamic forces, i.e., lift and drag. The drag has the effect of coupling the two oscillations, the deformations of flexure causing a torsional stress while deformations due to torsion permit the aerodynamic forces to produce bending stress. The conditions for stability are found by solving these equations. A new type of flutter can be shown as well as a new type of divergence both of which persist after the disappearance of the usual couplings, respectively in case where the centers of pressure, of flexure and of gravity coincide. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N69-16143 Oklahoma Univ., Norman.
THE INTERACTION AND MERGING OF FLAMES FROM BURNING LIQUIDS
Kenneth Glenn Huffman (Ph.D. Thesis) 1968 265 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.45 Order No. 68-9038

Six liquid fuels were studied using circular burners ranging in size from 1 1/4 to 6 inches in diameter, with burners of a particular size being arranged for most of the tests in a nine burner pattern. The effect of exposing the burner walls to radiation from adjacent fires was investigated by burning fires in both exposed-rim and rimless burners. The burning rate of the multiple fires, as well as the flame height and heat given off to the surroundings, was greatly enhanced at burner spacings for which the fires began to merge into a single fire column. After the center-burner burning rate peaked at this onset of merging, it dropped again as the flames became fully merged with further decreases in burner spacing. The values of radiation flux given off to the surroundings were found to closely follow the trends in burning rate as burner separation was varied. Empirical burning rate correlations were developed which allow the burning rate of interacting or merging, multiple, liquid-fueled fires to be predicted. Dissert. Abstr.

N69-16144 Illinois Univ., Urbana.
HEAT TRANSFER AND EXTINCTION CHARACTERISTICS WITH COMBUSTIBLE MIXTURES IN STAGNATION FLOW
Robert Gary Ladd (Ph.D. Thesis) 1967 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-8142

A combustible mixture of carbon monoxide and air in stagnation flow is reported. Numerical results based on a single step kinetic model illustrate the possibility of three steady states all satisfying the steady state equations for a given set of conditions. As a result of this multiplicity of states, an apparent extinction point may be defined. Also the heat flux to the solid surface may be obtained readily from the numerical solutions. Steady state stability is examined by linearizing the steady state equations and examining the effect of small disturbances by the Nyquist method. In cases for which three steady state solutions are found, the intermediate state is shown to be unstable to small disturbances in all cases. No instabilities are found for the other steady states. Quantitative measurements were made for carbon monoxide in air saturated with water for fuel lean mixtures. Extinction point, heat flux to the surface and distance between the flame and the surface were measured. The heat flux for representative compositions was found to be within 15% of the theoretically predicted values. Dissert. Abstr.

N69-16145 Michigan Univ., Ann Arbor.
THE DIRECT DETERMINATION OF THE ENTHALPY OF FLUIDS UNDER PRESSURE
Alan Edward Mather (Ph.D. Thesis) 1967 218 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-7666

The flow calorimeter recycle system was modified by the installation of a Corblin diaphragm compressor to prevent contact of the gas mixture with the compressor oil. The facility was used to obtain isobaric data on the effect of temperature on enthalpy for mixtures of 11.7 mole percent propane in methane, 28 mole percent propane in methane, and 43.4 mole percent nitrogen in methane. Detailed consideration of the various means of measuring the effect of pressure on enthalpy led to the throttling of an isothermal throttling calorimeter using a modified heater which consisted of an insulated resistance wire passing axially through the capillary. Measurements of the effect of pressure on enthalpy were made with nitrogen as a test gas at 147°F, 33°F, and 201°F at pressures from 2000 psia to 100 psia. The data are in agreement with values from the literature. Measurements were made on a mixture of 5.2 mole percent propane in methane at temperatures of 147°F, 27°F, 92°F, and 200°F. Isobaric measurements were also made on the 5.2 mole percent propane in methane mixture to extend the data from 80°F to 250°F. Dissert. Abstr.

N69-16146 Oklahoma State Univ., Stillwater.
FORCED CONVECTION BOILING FROM A CYLINDER NORMAL TO THE FLOW
Hugh Richard McKee (Ph.D. Thesis) 1967 188 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-8469

Heat transfer to water near the boiling point (12°F subcooled), was studied from cylinders with outside diameters of 0.2495 in., 0.338 in., 0.450 in., 0.553 in., and 0.707 in. constructed from type

304 stainless steel tubing. The circumferential temperature profile investigation showed the surface temperature to be independent of position for pool boiling and nearly independent of position for forced convection boiling. In forced convection boiling, the forward stagnation point was cooler than the rear stagnation point at low fluxes. At higher fluxes the forward point becomes hotter than the rear stagnation point, with burnout occurring in the wake region. Wall temperatures at the critical point for the pool boiling studies agreed with published pool boiling data. The critical flux decreased with an increase in cylinder diameter for both the pool boiling and forced convection boiling studies. Photographic investigations showed the vapor bubble diameter to be much larger than the calculated laminar boundary layer. Dissert. Abstr.

N69-16151 *# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
RADIATIVE TRANSFER IN THE MESOSPHERE
William Kuhn Dec. 1968 32 p refs Presented at the 3d Aeronomy Conf. on Meterol. and Chem. Factors in D-Reg. Aeronomy, Urbana, Ill., 23–26 Sep. 1968
(Contract NASr-54(03); ORA Proj. 05863)
(NASA-CR-99224; TR-05863-15-T) Avail: CFSTI CSCL 20M

The determination of radiative temperature changes for molecular gases under non-LTE conditions is discussed, with special emphasis on the microscopic formulation of the transfer equation. The radiative transfer and statistical equilibrium equations are combined to yield an explicit expression for the radiative temperature change. Mesosphere and lower thermosphere heating and cooling rates are calculated for the 15 μm CO_2 9.6 μm O_3 and the 80 μm H_2O bands and the spectral region from 1350 to 7550 A representing absorption of solar energy by O_3 and O_2. Maximum heating is found at the stratopause (5 deg per day) and mesopause (18 deg per day) over the summer pole while radiative cooling predominates in similar regions (−7 and −10 to −25 deg. per day respectively) over the winter pole. In the lower thermosphere, the radiative temperature change is strongly dependent on the collisional relaxation time. Author

N69-16181 *# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MULTIDIMENSIONAL GAS FLOW THROUGH PERMEABLE CHAR LAYERS AND ITS EFFECTS ON ABLATION
Harold G. Bush and Marvin B. Dow Washington Jan. 1969 39 p refs
(124-07-01-34-23)
(NASA-TR-R-298) Avail: CFSTI CSCL 20M

A theoretical analysis of the pressure fields within the char layers of cylindrical and hemispherical ablation models is presented. The distribution over the surface of mass flow from the char layer is given for both geometries. These multidimensional mass-flow distributions show that gas flow through the char layer can be significantly different from the one-dimensional assumption previously used by ablation analysts. Further, the theoretical results show that it is possible for the external pressure field to cause gas flow into the char layer, in which case the diffusion of energy and oxygen through the boundary layer to the material surface is increased. The appropriate analytical results were used to modify an existing one-dimensional ablation computer program to make convective blocking at the ablator surface responsive to the major parameters governing mass flow through permeable char layers. A comparison of analytical and experimental results shows that ablation performance can be significantly affected by multidimensional mass flow through the char layer. Author

N69-16199 Princeton Univ., N. J.
A STUDY OF THE MECHANISMS OF HEAT TRANSFER IN OSCILLATING FLOW
David Wells Bogdanoff (Ph.D. Thesis) 1968 336 p
Avail: Univ. Microfilms: HC $15.30/Microfilm $4.30 Order No. 68-9673

A dimensional analysis of the problem is carried out to establish the important non-dimensional parameters. Heat transfer and hot-wire measurements, together with data from the literature, are discussed to investigate the importance of viscous dissipation and acoustic streaming as means through which the oscillation affects the heat transfer in the flow. Eddy diffusivity profiles are computed which appear to give information on the regions of generation of 'abnormal' turbulence by the oscillation, and subsequent diffusion and decay of this turbulence. It appears that the effects of the oscillation on the turbulence exchange properties is the important mechanism through which the oscillation affects heat transfer in the flow. Possible applications of the effects of oscillations on heat transfer observed herein to heat exchanger design are described. It is concluded that the opportunities to apply longitudinal fluid oscillations to improve the performance of heat exchangers operating with turbulent gas flow in pipes are very limited. Dissert. Abstr.

N69-16237 Oklahoma State Univ., Stillwater
HEAT TRANSFER FROM A SPHERE TO LIQUID SODIUM DURING FORCED CONVECTION
Larry Claude Witte (Ph.D. Thesis) 1967 175 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-8527

Heat transfer rates from 1/2-inch diameter tantalum spheres to liquid sodium were measured as the sphere moved through a sodium pool. It was shown in this study that large amounts of subcooling in the liquid and motion of the sphere tend to prevent the formation of vapor at the surface of high temperature spheres. A theory was developed by assuming that no vapor was formed at the sphere surface and that superheating of liquid sodium near the surface could occur. This theory provides a simple technique for calculating heat transfer rates from high temperature spherical particles to highly subcooled liquids of high thermal conductivity. The film boiling theory, which was also developed in this study, was shown to represent only a first-order approximation of the actual heat transfer process. Dissert. Abstr.

N69-16268 *# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOLUTIONS OF BLUNT-BODY STAGNATION-REGION FLOWS WITH NONGRAY EMISSION AND ABSORPTION OF RADIATION BY A TIME-ASYMPTOTIC TIME-ASYMPTOTIC
Linwood B. Callis Washington Jan. 1969 55 p refs
(129-01-03-09-23)
(NASA-TR-R-299) Avail: CFSTI CSCL 20M

A second-order time-asymptotic solution to radiation-coupled stagnation-region flows is presented. The solution is applied to the hypervelocity flow over blunt vehicles of inviscid, nonconducting, equilibrium air, emitting and absorbing nongray radiation. Velocities, nose radii, and altitudes covered by the analysis are sufficient to bracket reentry trajectories of current interest. Radiative heat-transfer rates for the range of interest and typical profiles of pressure, density, enthalpy, temperature, and velocity are shown. The nature of the time-asymptotic solution is discussed and it is shown to be a feasible means of achieving second-order accurate solutions to radiation-coupled shock-layer flows. Step-function models of the absorption coefficient are used in order to evaluate the divergence of the radiation flux vector. An analysis is carried out to determine what effect variations in the spectral complexity of the step model absorption coefficients used in the analysis will have on the thermodynamic and flow profiles of interest and on the nongray radiative heat-transfer rates. An existing correlation for the cooling

factor, the ratio of the radiation heat-transfer rate to the adiabatic radiation heeat-transfer rate, is extended to larger velocities than heretofore considered. Author

N69-16291 Case Western Reserve Univ., Cleveland, Ohio.
MELTING ABLATION OF TWO DIMENSIONAL AND AXISYMMETRIC BLUNT BODIES WITH A BODY FORCE
Ching-Jen Chen (Ph.D. Thesis) 1967 264 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 68-10147

This work deals with the interaction of a gas stream with a melting blunt-nose body. The study is designed to gain a general and fundamental understanding of the melting phenomena and will not treat in detail other aspects of hypersonic re-entry or heat transfer. An order of magnitude analysis is first made to give a qualitative understanding of the melting characteristics. Then the equations describing both the gas and liquid flows are solved with proper matching at the gas-liquid interface. In this way the temperature at the gas-liquid interface and interface heat flux and, hence, the melting rate can be explicitly predicted for a given free stream condition. In past analyses the gas-liquid interface conditions were assumed. The question of what is the stable terminal body shape is answered. Dissert. Abstr.

N69-16412 National Lending Library for Science and Technology, Boston Spa (England).
THERMAL CONDUCTIVITY OF FIBROUS SYSTEMS [TEPLOPROVODNOST' VOLOKNISTYKH SISTEM]
G. N. Dul'nev et al Nov. 1968 12 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 14, no. 1, 1968 p 29-35 (NLL-RTS-4881) Avail: Natl. Lending Library, Boston Spa, Engl.: 17s 6d

The process of heat transfer in fibrous materials of irregular structure is examined. A method is suggested for estimating the value of effective thermal conductivity as a function of the determining parameters of the fibrous system (thermal components, their volumetric concentration, temperature, gas filler pressure, etc.). Author

N69-16437# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMBUSTION OF LIQUID FUEL DROPS IN A SOUND FIELD
V. Ye. Nakoryakov 11 Mar. 1968 16 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 12, no. 5, 1967 p 650-656 (AD-678822; FTD-MT-24-26-68) Avail: CFSTI CSCL 21/2

An approximate method for calculating combustion rates of liquid fuel drops in a sound field is proposed. The method is valid provided that certain restrictions are imposed on the values of the dimensionless complexes characterizing a process. The main result of the paper is expressed by rho formula (22): (qR)/(D. rho) = 1.17 (B/sq. rt. of (omega.D))|Beta; where q - quantity of fuel, vaporized in unit of time from unit of surface; rho - density of fuel vapors which relates the combustion rates to the sound oscillation parameters and to the intensity of a transverse flow of evaporating fuel vapors. Author (TAB)

N69-16428# Forsvarets Forskningsanstalt, Stockholm (Sweden).
APPROXIMATE CALCULATION OF MASS FLOW IN A ROTATING SOLID PROPELLANT ROCKET MOTOR WITH END-BURNING CHARGE [APPROXIMATIV BERAEKNING AV MASSFLOEDET I EN ROTERANDE KRUTRAKETMOTOR MED AEDFOERBRINNANDE LADDNING]
Rene Renstroem Aug. 1967 32 p In SWEDISH (A-2492-42) Avail: CFSTI

Combustion chamber pressures were calculated for both a loss-free flow and for a flow which is turbulent due to the process of combustion. The results are given in a diagram, with pressure as a function of a parameter made up of motor angular velocity, radius of the combustion chamber, radius of the smallest section, and a calculated turbulence parameter. Author

N69-16588 IIT Research Inst., Chicago, Ill.
SIMULTANEOUS CONDUCTION AND RADIATION IN AN INFINITELY LONG CYLINDER WITH A LINE SOURCE ALONG ITS AXIS
Wolfgang Wulff (Ph.D. Thesis) 1968 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-7834

Steady-state thermal conduction and radiation are analyzed for a nonscattering, optically gray medium whose thermophysical properties are independent of temperature. The problem is formulated for the axisymmetric case of an infinitely long straight circular cylinder with a line source of specified constant strength along its axis. The boundary is assumed to be optically black and to have a fixed temperature. The solution to the nonlinear integro-differential equation is developed through successive approximation, based on repeated linearizations. Three characteristic parameters govern the temperature profile. A method is proposed to determine experimentally the thermal conductivity and the absorption coefficient in a non-scattering, gray medium when conduction and radiation take place simultaneously. Dissert. Abstr.

N69-16613# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF THE PHOTOPYROMETRIC METHOD FOR DETERMINATION OF TEMPERATURE FIELDS
M. M. Skotnikov *In its* J. of Appl. Spectry. 17 Jan. 1968 p 17-23 refs (See N69-16610 06-34)
Avail: CFSTI

The photopyrometric method to determine brightness temperature and its application peculiarities are briefly described. The temperature range to be measured is specified. The conditions of applications of this method for the investigation of gases are also presented. Author

N69-16767 Oregon State Univ., Corvallis.
HEAT TRANSFER IN A FLUIDIZED BED TUBULAR HEAT EXCHANGER
William Ernest Genetti (Ph. D. Thesis) 1968 191 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-7830

Local and average heat transfer coefficients for heat transfer from an internal tube in a bundle of tubes to an air fluidized bed were investigated for both batch fluidization and fluidization with particle recycle. The fluidized bed heat exchanger was compared to a typical baffled heat exchanger in terms of pumping and space requirements. The fluidized bed tubular heat exchanger consisted of a 44-inch long, 5.75-inch inside diameter shell with 19, 3/4-inch diameter tubes arranged in a 1-1/16-inch triangular pitch. A cyclone separator was used to separate and return particles to the fluidized bed. Two types and three sizes of particles were used in this study. Glass spheres of 0.0052 and 0.0151-inch average diameter were used, and aluminum particles of 0.0306-inch average diameter were used. Tubes at the four possible tube locations were heated electrically. Dissert. Abstr.

N69-16774 Oklahoma Univ., Norman.
HEAT TRANSFER FROM UNCONTROLLED BUOYANT DIFFUSION FLAMES
De Witt Talmage Neill (Ph.D. Thesis) 1968 323 p
Avail: Univ. Microfilm: HC $14.65/Microfilm $14.15 Order No. 68-9042

This study was initiated to add to the limited knowledge of heat transfer from uncontrolled, buoyant diffusion flames by obtaining total heat transfer data for flames from a variety of liquid fuels. A second objective was to develop the necessary equations and compare several techniques for calculating the radiant heat transfer from the flames. A third objective was to compare the convective heat transfer rates determined as the difference between the measured total and the calculated radiant heat transfer rates, with the predicted convective heat transfer rates based on the available convective heat transfer coefficient correlations. Dissert. Abstr.

N69-16788*# General Electric Co., Philadelphia, Pa.
MODIFICATION OF THE ONE-DIMENSIONAL REKAP PROGRAM TO ALLOW FOR CHARRING IN THREE MATERIAL LAYERS Final Report
R. E. Price and F. E. Schultz 2 Jan. 1969 127 p refs
(Contract NAS3-10285)
(NASA-CR-72488; GE-RS-69SD420) Avail: CFSTI CSCL 20M

The one-dimensional reaction kinetics ablation program (REKAP) was modified in order to compute the thermal response of a layer body in which any or all of the first three layers may thermally degrade. The application of the modified program to one, two, and three charring layer problems is described, with emphasis on a rocket nozzle throat insert case. Author

N69-16789*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEAN GRADIENT HEAT TRANSFER IN ISOTROPIC TURBULENCE Progress Report
James C. Hill Jan. 1969 29 p refs
(NASA-TM-X-63440; X-641-69-6) Avail: CFSTI CSCL 20M

The problem of heat transfer of a constant-property fluid in isotropic turbulence in the presence of a uniform mean temperature gradient is examined. Three closures of the statistical moment equations are discussed: the first-iteration approximation, the third-cumulant discard, and the direct-interaction approximation. Evaluation of the thermal eddy diffusivity for the direct-interaction approximation requires solution of a nonlinear integro-differential equation for the averaged Green's function $G>$ for the temperature field. The numerical approximation of $G>$ was attempted in spatial coordinates to gain experience for shear-flow problems and so far is unsuccessful because of numerical difficulties associated with the singular nature of $G>$ at zero time. The calculation can best be done in wavenumber coordinates in which the Fourier transform of $G>$ is initially unity. Author

N69-16823# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
MODEL OF CRITICAL HEAT FLUX IN SUBCOOLED FLOW BOILING
Mario P. Fiori and Arthur E. Bergles Sep. 1968 157 p refs
(Contract F44620-67-C-0047)
(AD-679119; DSR-70281-68) Avail: CFSTI CSCL 20/13

The physical phenomenon occurring before and at the critical heat flux (CHF) for subcooled flow boiling has been investigated. The first phase of this study established the basic nature of the flow structure at CHF. A photographic study of the flow in a glass annular test section was accomplished by using microflash lighting. The results showed that the flow structure at CHF for high heat flux (1 to 5 million Btu/hr-sq ft), high subcooling (50-110F), at low pressures (less than 100 psia) was slug or froth flow depending on the mass velocity. Nucleation was shown to exist in the superheated liquid film. Pin-holes in the burned-out test sections suggested that the CHF condition was extremely localized. Flow regime studies in tabular and annular geometries, using an electrical resistance probe, provided further evidence of the slug or froth nature of the flow, and also showed that dryout of the superheated liquid film was not responsible for CHF. Since this evidence was contradictory to previously formulated models of CHF, a new model was proposed. Author (TAB)

N69-16842*# Michigan Univ., Ann Arbor. Heat Transfer Lab.
BOILING OF LIQUID NITROGEN IN REDUCED GRAVITY FIELDS WITH SUBCOOLING
Eugene W. Lewis, (Ph.D. Thesis) John A. Clark, and Herman Merte, Jr. May 1967 241 p refs
(Contract NAS8-20228)
(NASA-CR-98248; TR-2; Rept-07461-20-T) Avail: CFSTI CSCL 20M

Pool boiling of liquid nitrogen in a body force field less than standard gravity was studied using a transient calorimeter measurement technique. Experimental variables included: body forces from standard gravity to near-zero; a variety of geometries and orientations of the boiling surface; subcooling from 0° to 30°F; pressures from 1 to 5 atmospheres; and boiling regimes from film to nucleate, plus free convection. Subcooling was achieved by rapid pressurization of the liquid nitrogen; 3 and 5 atmospheres were used, providing maximum subcooling of approximately 20° and 30°F. Results were obtained in the form of time vs. surface temperature, which were then expressed as heat flux vs. the difference between the test surface temperature and saturated liquid temperature. In the film-boiling region, the heat flux on the spheres varied as diameter to the 1/8 power. Nucleate boiling, within the uncertainty of the measurements, was not affected by variations in acceleration, pressure, or subcooling. Author

N69-16871*# Pennsylvania State Univ., University Park. Mechanical Engineering Dept.
AN INVESTIGATION OF NEAR CRITICAL AND SUPER-CRITICAL BURNING OF FUEL DROPLETS Annual Report, 1 Sep. 1967–1 Sep. 1968
G. M. Faeth 30 Sep. 1968 13 p refs
(Contract NGR-39-009-077)
(NASA-CR-73654; AR-2) Avail: CFSTI CSCL 21B

The most significant achievement has been the verification of existing supercritical droplet combustion theories for various pressures, droplet sizes and ambient oxygen concentrations. Work was also begun on high pressure droplet gasification which included the development of a theoretical model of droplet heat-up in the presence of combustion. Preliminary experimental work in this area, to date, has included verification of evaporation models (without combustion) in gas environments at temperatures typical of combustion processes at atmospheric pressure. Author

N69-16937*# LTV Aerospace Corp., Dallas, Tex. Missile and Space Div.
COMPUTER PROGRAM FOR APOLLO FUEL CELL RADIATOR-CONDENSER COOLING SYSTEM ANALYSIS
J. A. Oren 17 Dec. 1968 205 p refs Revised
(Contract NAS9-2772)
(NASA-CR-92465; Rept-00-704) Avail: CFSTI CSCL 22B

Presented are analytical methods, user's instructions, and a sample problem for a generalized computer routine developed for the analysis of Apollo type fuel cell cooling loops. The routine methods are particularly suited to analysis of the fuel cell radiator.

primary to secondary loop condenser, and associated flow loops and controls. The routine can be used for simultaneous performance predictions of the entire secondary cooling loop and the condenser portion of the primary loop. Although the routine version presented was developed for the Apollo fuel cell cooling system, the generalized data input allows application to a wide range of space radiator and flow system problems. The generalized computer routine utilizes an explicit finite difference method to obtain steady state or transient heat transfer solutions. Thermal properties and dimensions are input directly without computing thermal capacitances or resistances. Multi-dimensional conduction heat transfer is easily accommodated by the generalized data input. Author

N69-17014# Denver Research Inst., Colo.
THE FEASIBILITY OF USING THE PRESSURE-TIME DATA FROM A SOLID-GAS REACTION AS A MEASURE OF THE REACTIVITY OF A PYROTECHNIC MATERIAL Final Report
Richard J. Fay Aug. 1968 43 p refs
(Contract N00164-67-C-0592)
(AD-679160; DRI-2469; NAD-CR-RDTR-133) Avail: CFSTI CSCL 19/1

A study was made of the feasibility of using the pressure-time curve generated by the reaction of a solid pyrotechnic material with a referee gas in a closed vessel as a measure of the reactivity of the material. It was found that fuels such as magnesium, aluminum, and boron could be reacted with oxygen while oxidizers such as sodium nitrate, potassium permanganate, and manganese dioxide could not be reacted energetically with hydrogen or carbon monoxide. The results from studies of magnesium reacted with oxygen indicate that the relative reactivity of powdered magnesium prepared by atomization and balling can be distinguished by the slope on the log-log plot of the pressure-time curve. Author (TAB)

N69-17143# Los Alamos Scientific Lab., N. Mex.
THERMAL DIFFUSION OF SX-5 GRAPHITE FROM 800° TO 2800° C
B. H. Morrison [1968] 19 p refs Presented at 8th Ann. Conf. of Thermal Conductivity, Lafayette, Ind.
(Contract W-7405-ENG-36)
(LA-DC-9969; CONF-681009-9) Avail: CFSTI

The thermal diffusivity of SX-5 graphite in orthogonal axes was measured at 800 to 2800°C by the laser flash technique in a vacuum and in a helium atmosphere. A neodymium glass laser system was the pulsed energy source; a photomultiplier tube was used to detect the transient-time temperature response of the thin samples. Cowan's method for correction of the heat loss and a finite pulse time correction were included in the thermal diffusivity calculations. The thermal diffusivity data were fitted to a function in reciprocal temperature by a least squares technique. The precision of the flash technique was certified by repeated measurements on many samples. The accuracy of the measurements was estimated by comparison with published high temperature thermal conductivity data on other graphites and on Armco iron. Author (NSA)

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N69-16331# McDonnell-Douglas Co., Santa Monica, Calif. Western Div.
COMPLETE SYSTEM ANALYSIS: QUANTITATIVE SYSTEM ANALYSIS, COMPUTER SIMULATION, AND SYSTEM OPTIMIZATION
A. F. Goodman, L. Gainen, and C. O. Beum, Jr. (N. Am. Rockwell Corp.) Sep. 1968 63 p refs Presented to Am. Inst. of Aeron. and Astronautics 1967 Lecture Ser., Los Angeles, 7 Mar. 1967
(Douglas-Paper-4431) Avail: Issuing Activity

Many systems and processes in use today are quite complex, and experimentation regarding them is both difficult and expensive. For such systems or processes, mathematical solution for outputs in terms of inputs is usually not feasible, and computer simulation is often an effective and efficient complement to experimentation. Complete system analysis is a general approach to the coordination of experimentation and computer simulation in the analysis and optimization of a system or process. In addition, it is somewhat novel in its approach. Three basic stages of complete system analysis are quantitative system analysis, computer simulation, and system optimization. Author

N69-16569*# Illinois Univ., Urbana. Coordinated Science Lab.
PROGRESS REPORT FOR MARCH–AUGUST 1968
30 Sep. 1968 433 p refs
(Grant NsG-228-62; Contracts DAAB07-67-C-0199; DAAK02-67-C-0546; N00014-67-A-0305-0001; OE-C-1-7-017213-4557 et al
(NASA-CR-99223) Avail: CFSTI CSCL 20

Measurements on ion emission from polycrystalline tungsten due to electron bombardment were performed for hydrogen, carbon monoxide, and nitrogen. Component materials for the development of solid state infrared converters were evaluated and data on resistivity and spectral properties of cadmium sulfide films reported. Unstable oscillations were observed at plasma boundaries during the interaction of an electron beam with a plasma. Monte Carlo solutions were obtained for nonlinear Boltzmann equations of shock waves. A statistical study associated cathode whiskers with electrical breakdown initiation. The development of optimal orbit and spin-orbit parameters based on a new data analysis simulation for the relativity satellite was obtained. Also reported were various studies on semiconductor physics, computer and information sciences, seismic detection, and urban development. G.G.

N69-16610# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF APPLIED SPECTROSCOPY COLLECTION OF ARTICLES
17 Jan. 1968 208 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (USSR), v. 6, no. 2, 1967 p 1-281
(AD-679370; FTD-HT-23-1372-67) Avail: CFSTI CSCL 7/4

The articles presented cover spectral analysis techniques and instrumentation, laser developments, and new instrumentation and materials. For individual titles see N69-16610 through N69-16642

N69-16644*# Denver Research Inst., Colo. Industrial Economics Div.
PROJECT FOR THE ANALYSIS OF TECHNOLOGY TRANSFER: THE INITIAL YEAR Annual Report, 13 Nov. 1967–12 Nov. 1968
Theodore D. Browne, Richards O. Morgan, Dean R. Lessley, William M. Hildred, and Dean C. Coddington 13 Nov. 1968 64 p refs
(Contract NSR-06-004-063)
(NASA-CR-99235) Avail: CFSTI CSCL 05B

The purpose of the project is to provide data on the secondary uses made of technology developed by NASA and AEC, and to

provide for a better understanding of the technology transfer process. Toward this end, efforts were made to identify cases of space technology transfer, to document the circumstances surrounding the use of such aerospace information, to design and implement a Transfer Data Bank, and to analyze the resulting data to assist NASA with technology transfer activities. The information in this report is presented in the following form: (1) a background discussion of technology transfer; (2) a description of research activities, contents of earlier reports, and resulting publications; and (3) analyses and recommendations regarding data collected during the first year of the program. K.W.

N69-16931# New Mexico Univ., Albuquerque.
VISTAS IN SCIENCE Final Report
David L. Arm. Nov. 1968. 168 p refs
(Grant AF-AFOSR-1520-68)
(AD-679198; AFOSR-68-2760) Avail: CFSTI CSCL 5/2

This volume is a collection of articles based upon lectures presented at the Thirteenth Science Seminar of the Air Force Office of Scientific Research, held at Albuquerque, New Mexico, in June 1968. This book is not a verbatim transcript of the lectures which were presented. Instead, its chapters, written after the conclusion of the seminar by the people who appeared on the program, are, in the main, digests of what was discussed in the lectures and in the discussion periods. They cover the microwave sky, glass technology, aerodynamic shapes, arc jets, biological sensors, and fluorine chemistry. TAB

N69-16934# Air Force Office of Scientific Research Washington, D. C.
LONG RANGE FORECASTING METHODOLOGY
Joseph P. Martino and Thomas E. Oberbeck. [1968] 197 p
(AD-679176; AFOSR-68-0049) Avail: CFSTI CSCL 5/1

The document consists of the Proceedings of the Second Symposium on Long Range Forecasting and Planning held at Alamogordo, New Mexico, 11-12 October 1967. The papers presented discussed technological forecasting, population forecasting and weather forecasting. Discussion of each paper is included. Author (TAB)

N69-16963# Dartmouth Coll., Hanover, N. H. Dept. of Psychology.
UNCERTAINTY, INFORMATION SEARCH AND DECISION MAKING Final Report
John T. Lanzetta. Nov. 1968. 13 p
(Contract AF 49(638)-1614)
(AD-678603; AFOSR-68-2324) Avail: CFSTI CSCL 5/10

The research has examined several independent and dependent variables. The dependent variables selected for attention were the amount of information acquisition and information processing. The independent variables focused upon were the cost of information, time pressure, level of aspiration, degree of initial uncertainty, rate of uncertainty reduction, and schedules of reinforcement. In addition, the prominence of individual differences in information acquisition stimulated some of search behavior. Twelve papers have been published in scientific journals on this research. Author (TAB)

N69-16966# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
RESEARCH OF AERODYNAMIC PHYSICS INSTITUTE FOR PROJECT STRATEGIC TECHNOLOGY Semiannual Technical Summary, Period Ending 30 Sep. 1968
Martin H. Bloom. Oct. 1968. 24 p refs
(Contract Nonr-839(38); ARPA Order 529)
(AD-678762; PIBMRI-1295.7-68) Avail: CFSTI CSCL 20/4

The report contains a compilation of abstracts of papers which were either accepted for publication or were published. The papers are on the subjects of fluid dynamics, electromagnetics and plasmas. The report also contains a listing of papers submitted to journals, lectures, internal reports and staff activities. Author (TAB)

N69-16991# RAND Corp., Santa Monica, Calif.
PRODUCTION CORRESPONDENCES
S. E. Jacobsen. Nov. 1968. 44 p refs Submitted for publication
(AD-678992; P-3974) Avail: CFSTI CSCL 12/2

Production correspondences are defined and their properties explored. Properties of the distance function of a production structure are studied and are related to properties of the correspondence. Homotheticity is generalized to allow discontinuities in returns to scale and to make cognizance of several outputs. The factorization of the distance function into the product of two functions, one depending only on output and the other only on input, is then demonstrated. The cost function is then shown to give rise to a production structure. A Shephard-type duality theorem is then proven which implies, among other things, that the cost function and the distance function are dually related; that is, given one, a minimization problem yields the other. The duality theorem is then used to deduce necessary and sufficient conditions, in terms of the cost function, for a production correspondence to be homothetic. A few simple applications of the duality theorem are given which relate properties of the cost function to geometric properties of the correspondence. Author (TAB)

N69-17044# Associated Western Universities, Inc., Salt Lake City, Utah.
THE ROLE OF ASSOCIATED WESTERN UNIVERSITIES
G. Victor Beard. *In* Los Alamos Sci. Lab. 1st LAMPF Users' Meeting Sep. 1968 p 19-21 (See N69-17041 08-11)
Avail: CFSTI

The operation and financial organization of Associated Western Universities, a nonprofit corporation composed of member universities for the purpose of enhancing and furthering nuclear education at the graduate level, is discussed. The organization at present is largely a captive of the Atomic Energy Commission, since two-thirds of its funding comes from the AEC Division of Nuclear Education and Training. Cooperative programs between the universities and nine nuclear research laboratories is the primary function, and the desire to organize a similar program with the newly established Los Alamos Meson Physics Facility is introduced. A.C.R.

N69-17079# Joint Publications Research Service, Washington, D. C.
PHILOSOPHICAL PROBLEMS OF FORECASTING AND ORGANIZING USSR SCIENCE
10 Jan. 1969. 85 p refs Transl. into ENGLISH from Vopr. Filosofii (Moscow), no. 10, 1968 p 11-45, 93-102, 136-154
(JPRS-47228) Avail: CFSTI

CONTENTS:

1. FORECASTING AND DIALECTICS A. Bauer et al p 1-14 refs (See N69-17080 08-34)
2. FORECASTING SCIENTIFIC-TECHNICAL PROGRESS I. G. Kurakov p 15-35 refs (See N69-17081 08-34)
3. CERTAIN PROBLEMS OF ORGANIZATION OF SCIENCE IN THE EPOCH OF THE SCIENTIFIC-TECHNICAL REVOLUTION M. K. Petrov p 36-80 refs (See N69-17082 08-34)
4. DISCOVERY OF THE MULTIPLICITY OF MATHEMATICS AND ITS PHILOSOPHICAL SIGNIFICANCE E. Kolman p 81-85 refs (See N69-17083 08-19)

5. METHODOLOGICAL PROBLEMS OF THE INFORMATION THEORY (A REVIEW OF THE LITERATURE) p 66-91 refs (See N69-17084 06-34)

6. PROBLEMS OF THE STUDY OF STRUCTURAL LEVELS OF BIOLOGICAL SYSTEMS A. T. Shtalov p 92-98 refs (See N69-17085 06-04)

N69-17080# Joint Publications Research Service, Washington, D. C.

FORECASTING AND DIALECTICS

Adolph Bauer et al. *In its* Phil. Probl. of Forecasting and Organizing USSR Sci. 10 Jan. 1969 p 1-14 refs (See N69-17079 06-34)

Avail: CFSTI

The expanding functions of social process forecasting are discussed in the context of the ideological struggle between the socialist system and the State-monopolistic capitalism system, and the need for a comprehensive development of the theory of social prognostics including its philosophical aspects. A distinction is drawn between scientific forecasting and empirical predictions which are considered inadequate for the creative application of the Marxist-Lenin theory. The methodological problems encountered in providing the informational basis for the forecast are discussed in terms of direct and indirect methods. It is shown that the Marxist-Lenin dialectics in the field of social forecasting has an extremely important methodological value. M.G.J.

N69-17081# Joint Publications Research Services, Washington, D. C.

FORECASTING SCIENTIFIC-TECHNICAL PROGRESS

I. G. Kurakov *In its* Phil. Probl. of Forecasting and Organizing USSR Sci. 10 Jan. 1969 p 15-35 refs (See N69-17079 06-34)

Avail: CFSTI

The necessity for long-term forecasting of science, technology, and production is stressed. The most important factors involved in such forecasting are seen as the objective relationships between the production of knowledge and the growth of the country's economy and a theoretical explanation of these relationships. The rates of growth of the Soviet national income under the various Five-Year Plans are given. Consideration is also given to the social side of the development of knowledge, such as the basic factors affecting the real income of the workers and the interaction of these factors. These are identified as labor productivity, or the degree of utilization of human labor; and the returns of the industrial capital, indicating the degree of utilization of the materialized labor. Also considered important is the establishment of the optimum relationships between the development of the economy by means of increasing the amount of products produced in the country, and its development by means of increasing the value of the products to the consumers. M.G.J.

N69-17082# Joint Publications Research Service, Washington, D. C.

CERTAIN PROBLEMS OF ORGANIZATION OF SCIENCE IN THE EPOCH OF THE SCIENTIFIC-TECHNICAL REVOLUTION

M. K. Petrov *In its* Phil. Probl. of Forecasting and Organizing USSR Sci. 10 Jan. 1969 p 36-50 refs (See N69-17079 06-34)

Avail: CFSTI

The phenomenal growth of allotments for science and the increasing number of scientists is discussed from the viewpoint that eventually science will reach saturation. It is theorized that the volume of scientific activity will be stabilized in comparison with other forms of socially useful activity, scientific workers will form a definite percentage of the able-bodied population, and the allotments for this activity will amount to a certain established share of the budget. The problem of organization of scientific activity is seen as raising the labor productivity and reducing the expenditures per unit of scientific product. Author

N69-17084# Joint Publications Research Service, Washington, D. C.

METHODOLOGICAL PROBLEMS OF THE INFORMATION THEORY—A REVIEW OF THE LITERATURE

In its Phil. Probl. of Forecasting and Organizing USSR Sci. 10 Jan. 1969 p 66-91 refs (See N69-17079 06-34)

Avail: CFSTI

Several aspects of the philosophical-methodological problems of information theory are discussed, and the growing interest in the philosophical questions of information theory is noted. A review of Soviet literature shows that attention was centered in the general areas of (1) specifics of the philosophical analysis of the theory of information, (2) quantitative aspect of information, (3) qualitative aspect of information, (4) volume and content of the information concept, (5) matter, consciousness, and information, (6) reflection and information, (7) information and thinking, (8) information and development, (9) causality and information, (10) system and information, and (11) entropy and information. Certain shortcomings in the literature are pointed out, such as the lack of new ideas on the relationship between information and reflection, and new statements on methodological and philosophical problems of the theory of information. M.G.J.

N69-17086# Electronic Systems Div., Bedford, Mass. Cost Analysis Div.

AN INDEX FOR USE IN THE SELECTION OF COST EFFECTIVE SYSTEMS

Walter G. Hartung Oct. 1968 36 p refs

(AD-678514; ESD-TR-68-426) Avail: CFSTI CSCL 14/1

Life-cycle cost alone is not sufficiently inclusive to be used as a yardstick for the selection of a cost effective system. Equal life-cycle cost does not imply equal cost effectiveness. An index is developed which in addition to life-cycle cost, includes cost effective life span, expenditure chronology, system phase-in structure, and the present equivalent cost of money expended at a future date. Although the index does not determine military effectiveness, it does permit the cost comparison of various systems or programs on a logically compatible and equivalent basis. Author (TAB)

N69-17124# Congress. House. Committee on Science and Astronautics. Subcommittee on Science, Research, and Development.

INSTITUTIONAL GRANTS BILL, H.R. 876

Washington GPO 1968 393 p refs Hearings before the Subcomm. on Sci., Res., and Develop., 90th Congr., 2d Sess., No. 9, 25 Jun.-18 Jul. 1968

Avail: Issuing Activity

Testimony is presented on various facets of a bill to promote the advance of science and the education of scientists through a national program of institutional grants to the colleges and universities of the United States. Data are given on the state distribution of development programs from the inception of the program to June 21, 1968. Reports are included on the Federal financing of higher education, and on Government attitudes towards research. M.G.J.

N69-17126# Congress. House. Committee on Science and Astronautics. Subcommittee on Science, Research, and Development.

EARTH RESOURCES SATELLITE SYSTEM

Washington GPO 1968 32 p refs

Avail: Issuing Activity

Data are presented in support of the earth resources satellite system and the development of the Earth Resources Technology Satellite (ERTS). The system is considered to have the potential for making major contributions to the solution of mankind's food, water, and mineral resource problems, and to provide an opportunity for achieving tangible economic returns from the substantial space program expenditures. The existing technological base for an operational ERTS design is reviewed, and the history of the program is traced. Scientists in six key areas are generally considered to be the most important potential users of earth resources data. These areas are cartography, agriculture, forestry, oceanography, geology, and hydrology. It is strongly recommended that NASA concentrate a much larger portion of its efforts and resources on this project, and the launch schedule should be compressed if possible. M.G.J.

N69-17187# Joint Publications Research Service, Washington, D. C.

USSR ACHIEVEMENTS IN SPACE RESEARCH (FIRST DECADE IN SPACE, 1957–1967)

A. A. Blagonravov, ed., et al 24 Jan. 1968 624 p refs Transl. into ENGLISH of the book "Uspekhi SSSR V Issledovanii Kosmicheskogo Prostranstva. Pervoye Kosmicheskoye Desyatiletiye 1957–1967" Moscow, Nauka, 1968 p 1–557 (JPRS-47311) Avail: CFSTI

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2. STUDIES OF THE UPPER ATMOSPHERE WITH ROCKETS AND SATELLITES M. G. Kondratyev p 16–74 refs (See N69-17188 06-13)
3. SOME IONOSPHERIC STUDIES BASED ON ANALYSIS OF RADIO WAVES EMANATING FROM ARTIFICIAL EARTH SATELLITES Ya. L. Alpert p 75–111 refs (See N69-17189 06-13)
4. THE EARTH'S RADIATION BELTS S. N. Vernov et al p 112–160 refs (See N69-17190 06-29)
5. COSMIC RAYS S. N. Vernov et al p 161–187 refs (See N69-17191 06-29)
6. STUDIES OF THE MAGNETIC FIELDS OF THE EARTH AND PLANETS Sh. Sh. Dolginov et al p 188–273 refs (See N69-17192 06-13)
7. LUNAR STUDIES A. A. Mikhaylov et al p 274–306 refs (See N69-17193 06-30)
8. PLASMA IN INTERPLANETARY SPACE K. I. Gringauz p 307–333 refs (See N69-17194 06-29)
9. STUDIES OF SOLAR SHORT-WAVE RADIATION S. L. Mandelshtan p 334–364 refs (See N69-17195 06-29)
10. SPACE BIOLOGY AND MEDICINE O. G. Gazenko p 365–422 refs (See N69-17196 06-04)
11. OPTICAL OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES AND THEIR IMPORTANCE FOR GEODESY AND GEOPHYSICS 423–480 refs (See N69-17197 06-13)
12. PRINCIPAL RESULTS OF TEN YEARS OF SPACE RESEARCH A. G. Masevich p 481–510 (See N69-17198 06-34)
13. SOVIET ARTIFICIAL EARTH SATELLITES, SPACECRAFT AND THEIR TECHNICAL CHARACTERISTICS. APPENDIX V. V. Bazykin p 511–615 (See N69-17199 06-31)

N69-17198# Joint Publications Research Service, Washington, D. C.

PRINCIPAL RESULTS OF TEN YEARS OF SPACE RESEARCH

A. G. Masevich *In its* USSR Achievements in Space Res. 24 Jan. 1969 p 481–510 (See N69-17187 06-34) Avail: CFSTI

Developments in rocket and space technology and astrophysics during the ten years since the first launch of a Soviet earth satellite are summarized. Scientific and technical problems involved in design, launch, experimental programs, and recovery systems are included. The Elektron satellites, designed to measure the geomagnetic field, radio emission, solar X-rays, and atmospheric composition, are described; and the Soviet lunar program, originating with the Luna space probes, is treated. Manned space flight, as exemplified by the Voshkod Vostok, and Soyuz spacecraft is then considered, followed by a summary of the most important scientific results obtained from the entire Soviet space program. A.C.R.

N69-17081

FORECASTING SCIENTIFIC-TECHNICAL PROGRESS

The capacity to long-term forecasting of science, technology, and production is increased. The most important factors involved in such forecasting are even as the objective relationships between the production of knowledge and the growth of the country's economy and a theoretical explanation of these relationships. The rates of growth of the Soviet national income under the various Five-Year Plans are given. Consideration is also given to the social role of the development of knowledge, such as the basic factors affecting the real income of the workers and the interaction of these factors. These are identified as labor productivity or the degree of utilization of human labor, and the returns of the industrial sphere, indicating the degree of utilization of the material base. Also considered important to the accomplishment of the optimum relationship between the development of the economy by means of increasing the amount of products produced in the country, and its development by means of increasing the value of the products to the consumer.

M.G.J.

N69-17082

CERTAIN PROBLEMS OF ORGANIZATION OF SCIENCE IN THE EPOCH OF THE SCIENTIFIC-TECHNICAL REVOLUTION

M. K. Petrov. In its Prob. of Forecasting and Organizing USSR Sci. 10 Jan. 1969 p. 35-50 refs (Sec N69-17078 06-34) Avail. CFSTI

The phenomenal growth of standards for science and the increasing number of scientists is discussed from the viewpoint that eventually society will reach saturation. It is theorized that the volume of scientific activity will be stabilized in comparison with other forms of society (even so) only: scientific workers will take a definite percentage of the active population, and the requirements for this activity will attain that certain established share

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